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ABSTRACT

This report presents existing workforce levels, training programs and career potentials and develops staffing level projections (1976-1982) based on available information for the State of Michigan. The study concerns itself with the environmental pollution control areas of air, noise, potable water, pesticides, radiation, solid waste, wastewater, and energy. The format includes workforce profiles, projections, growth and career options for each of the areas investigated. Additional sections of the report outline state legislation and selected post secondary institutions with formal Environmental/Energy programs. A state profile and summary is included for cross-reference. The selected bibliography is appended in the Region V report. This document is one in a series of 69 which presents information for each of the states, Washington, D.C., Puerto Rico, and the Virgin Islands, and national and regional summaries. (CS)

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A National Environmental/Energy Workforce Assessment

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NATIONAL ENVIRONMENTAL/ENERGY

WORKFORCE ASSESSMENT

for

MICHIGAN

Conducted by:

NATIONAL FIELD RESEARCH CENTER, INC

Under Grant from:

UNITED STATES

ENVIRONMENTAL PROTECTION AGENCY

Grant #T900591010

1977

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PREFACE

This study presents an analysis of existing workforce levels, training programs, and career potentials and develops five-year staffing level projections (1976 to 1982) based on available information for the State of Michigan in the environmental pollution control areas of air, noise, pesticides, potable water, radiation, solid waste, wastewater, and energy. This report is one portion of a study of the fifty states, Puerto Rico, and the Virgin Islands that was conducted by National Field Research Center, Inc., of Iowa City, Iowa.

The data presented in this report was compiled through comprehensive on-site interviews with professionals working in the public and private sectors. Supplementing this method were telephone surveys, mail contact, program plans, and research of relevant literature. It should be pointed out that the data, where not documented by records, represents the best professional judgment of these experts.

FOREWORD

Information for this report was largely compiled from on-site interviews with professionals within Michigan's state agencies with environmental protection functions and with professionals engaged in pollution control activities in the private sector. To strive for a higher degree of reliability, interviews were supplemented with telephone research. It should be noted that a large portion of the information contained herein represents the best professional judgments of those persons surveyed. The term "sources in the field" is used in this report to denote the pollution control professionals who provided information for the project. In cases in which more than one person provided input into a single program area, compilation of figures and recommendations was provided by the author. Much of the background material on agency programs, functions, and activities was obtained from program plans of the appropriate agencies.

This report provides information on the following eight pollution control fields: air, noise, pesticides, potable water, radiation, solid waste, wastewater, and energy. In Section C of each chapter entitled, Workforce Projections, average per annum growth/decline rates are derived by first calculating each year's growth rate for each category. The sum of these figures under each category is then found and is divided by the total number of years, i.e., by five.

Within the agencies and industries that were researched, compartmentalization of employees into the eight pollution control areas is not

necessarily a clearcut situation. Functions occasionally overlap, inter-divisional cooperation occurs, and certain components serve a supporting role to an entire agency. Efforts were made in the preparation of this report to provide sufficient information for the reader to have a understanding of those segments of the workforce that play a major role in environmental protection activities and to provide divisions in a logical, realistic, and understandable manner.

National Environmental Energy
Workforce Assessment

Phase I

MICHIGAN

State Summary

I. AIR

Primary responsibility for the adiministration of Michigan's air pollution control program lies with the Michigan Department of Natural Resources (MDNR), Bureau of Environmental Protection, Air Quality Division. Division operations are carried out through a central office and nine district offices. The total professional and technical staffing level is currently 52 persons. The central office is staffed by 31 professional and technical persons, and the remaining 21 persons are allocated to the district offices. While staff is needed for program efficiency, insufficient budget allocations will not permit significant growth during the next five years.

Laboratory support for the state air program is provided by the Laboratory Section, Environmental Services Division, MDNR. Three chemists and two laboratory technicians are involved in air analysis. Staff increases of two persons per year are projected for the Section through 1981.

Local air pollution control programs are administered in Wayne County, Macomb County, Muskegon County, and the City of Grand Rapids. A total of 79 persons, mostly engineers and scientists, are employed through these programs. No growth is projected for the next five years.

Sources estimate that as many as 1,000 engineers, scientists, and technicians are involved in air pollution control activities in the private sector. Five percent per annum growth is projected for the next five years.

II. NOISE

The Michigan Department of State Highways and Transportation is the most active state agency in the control of environmental noise. Two divisions of the Department are involved in noise control, the Environmental and Community Factors Division and the Testing and Research Division. In the Environmental and Community Factors Division, two staff members allocate approximately fifteen percent of their time to noise activities, and in the Testing and Research Division, three engineers and one technician are active in environmental noise. Sources indicate that no growth in their staff or in the time spent on noise control activities is expected.

The OSHA industrial noise control program is regulated by the Michigan Department of Public Health, Bureau of Occupational Health and Environmental Health, Division of Occupational Health. This Division has a staff of 50 persons, mostly engineers, who devote a small portion of their time to monitoring and enforcement of industrial noise control regulations. No growth is expected in the OSHA program through 1981.

Noise activities in the private sector are extremely limited. Sources indicate that at least 50 persons employed in auto companies are involved in research and development methods related to noise reduction in trucks and automobiles. No growth projections were available for this segment of the workforce.

III. PESTICIDES

The Michigan Department of Agriculture is the state lead agency for the pesticide applicator certification program. Within the Department, the Plant Industry Division (PID) is responsible for administering and implementing the state certification plan and conducting regulatory activities. The PID has a professional staff of 70. Professional specialities include entomology, plant pathology, horticulture, biology, agriculture, botany, or forestry. In total, an estimated eight person years are allocated to pesticide programs. Sources indicate that an increase of ten to fourteen staff members will be required over the next five years.

The Michigan State Cooperative Extension Service, which has responsibility for developing the applicator certification training programs, is staffed with a full-time coordinator and nine training specialists. An additional 25 persons provide supportive services to the specialists. No growth in personnel is expected during the next five years.

Other state agencies involved with pesticide control include the Michigan Department of Public Health and the Michigan Department of Natural Resources. A total of ten persons in these agencies are active in pesticide programs. No growth is foreseen through 1981.

Sources estimate that there are 2,040 commercial applicators and 25,000 farmers involved in pesticide use. Projections in the private sector include a 10 percent per annum growth in commercial appliçators through 1981.

IV. POTABLE WATER

The Michigan Department of Public Health, Bureau of Environmental and Occupational Health, Division of Water Supply is the primary state agency responsible for the potable water program. The Division presently has a professional staff of eighteen which consists of 15 engineers, 1 chemist, and 2 administrators, As the Division proceeds to implement the Safe Drinking Water Act, staff requirements are expected to grow to a total of 113 persons, with the greatest growth in the sanitarian category.

Laboratory analysis is conducted by the State Public Health Laboratory. Approximately 16 person-years of effort is devoted to potable water laboratory analysis. Staffing of the laboratory is expected to double during the next five years as a consequence of the Safe Drinking Water Act.

There are an estimated 1,367 operators employed in distribution systems, filtration systems, disinfection systems, and other miscellaneous treatment systems. The disinfection systems employ a total of 419 operators; miscellaneous systems, 419; filtration systems, 298; and, distribution systems, 231. During the next five years, the most significant private sector increase will be in the demand for distribution systems operators. In excess of 1,000 communities may require certified distribution system operators. An increase of nine percent per annum is also projected for the growth in demand filtration system operators.

V. RADIATION

Primary responsibility for radiation protection is vested in the Michigan Department of Public Health, Bureau of Environmental and Occupational Health, Division of Radiological Health. The Division has a professional staff of eleven which includes 1 engineer, 7 physicists, 1 chemist, 1 technician, and 2 other. Over the next five years, the environmental monitoring staff of the Division will probably increase by approximately two persons.

Private sector data concerning numbers of individuals employed in radiation protection is not available at this time. There are approximately 226 facilities in Michigan using industrial X-ray devices in Michigan. Each of these facilities is likely to have a safety officer, often an industrial hygienist, responsible for the proper use of equipment. In addition, approximately 1,838 hospital and clinics use medical diagnostic machines. It is feasible that each of the facilities employ one person, frequently a health physicist, to care for the equipment. Limited workforce projections are available for the private sector. Five nuclear power plants are scheduled for operation during the next five years. This undoubtedly will cause an increase in the number of health physicists and other personnel employed in radiation protection.

VI. SOLID WASTE

Responsibility for solid waste management has been assigned to the Michigan Department of Natural Resources, Resource Recovery Division. The Division is staffed with a total of eleven professionals which includes 4 engineers, 5 sanitarians, and 2 geologists. Sources in the Division indicate that they anticipate adding fourteen professional members to the staff during the next five years. These staff members are required for increased surveillance, hazardous waste, and resource recovery activities. Further expansion may result from the implementation of a hazardous waste program as mandated through the Resource Conservation and Recovery Act.

Private sector estimates include about 13,000 persons who are employed in solid waste collection and disposal activities in the state. There are approximately 600 landfills in the state, only 350 of which are licensed sanitary landfills. Sources indicate that there are an estimated 1,205 persons employed at the landfills. A total of about 12,500 persons may be employed in collection systems, with 5,000 of the persons serving as drivers. In addition, Michigan has 70 operable transfer stations which are staffed by a total of 90 persons. Michigan does not have, as yet, any municipal resource recovery facilities. The collection system workforce is expected to increase by about 500 employees per year for the next five years. This growth is attributed to the closing of open dumps and the continual growth in the quantities of solid waste generated. Minimal growth is also anticipated for the workforce in the transfer systems.

VII. WASTEWATER

Operating under the Water Resources Commission, the Water Quality Division of the Michigan Department of Natural Resources, Bureau of Environmental Protection is responsible for the administration of Michigan's water pollution control program. The Division is presently staffed with 79 professional and technical personnel including 34 engineers, 14 biologists, 5 technicians, 7 water quality administrators, 5 water quality supervisors, 5 conservation planners, 5 water rsource planners, 3 wastewater treatment specialists, and 1 bacteriologist. While there is a demonstrated need for doubling the staffing of the Division, sources anticipate that over the next five years only about fifteen additional positions will be authorized.

The Environmental Services Laboratory provides approximately sixteen person-years of effort to water analysis. Over the next five years, the Laboratory expects to increase its staff by about thirty-five persons.

The municipal wastewater treatment facilities may employ up to 3,100 persons, and private industry employs approximately 1,178 operators certified for industrial and commercial wastewater treatment. Although municipal treatment facilities will be expanding, limited growth in the number of treatment operators is expected. Sources indicate that only 200 new certified operators will be needed. Minimal growth is projected for the industrial sector.

VIII. ENERGY

The Energy Administration of the Michigan Department of Commerce has been delegated responsibility for developing and coordinating state energy policy. The Administration has a professional staff of fourteen persons: 1 director, 2 deputy directors, 1 administrative assistant, 3 research and policy analysts, 1 fuel allocation officer, 1 education coordinator, 3 conservation coordinators, 1 energy information specialist, and 1 wood energy specialist. Sources anticipate a growth of approximately ten additional positions over the next five years.

The Michigan Energy and Resources Research Association is a consortium of representatives from state government, universities, and industry. The function of the Association is to obtain funding to conduct energy-related research and to utilize the available expertise in carrying out the projects. The staff consists of its part-time president and one full-time research person. No staff projections are available for the association.

Private sector workforce projections are limited. Sources indicate that the major utilities in Michigan have been active in the energy field. They are active in research in the areas of coal gasification, direct combustion systems, and the feasibility of solar and wind power usage. No estimates are available on the number of persons employed in these activities. Sources indicate significant growth in the private sector energy-relat programs during the coming five years.

STATE OF MICHIGAN - SUMMARY

National Environmental/Energy Workforce Assessment
Pollution Control & Abatement Personnel
Projected Workforce Requirements (1976-1981)

Environmental Area	1976	1977	1978	1979	1980	1981	%/annum growth (average)
AIR	1,136	1,186	1,236	1,286	1,336	1,386	4%
NOISE [1]	6	6	6	6	6	6	0
PESTICIDES	27,145	27,351	27,577	27,826	28,100	28,401	1%
POTABLE WATER [2]	1,170	1,210	1,276	1,336	1,399	1,439	4%
RADIATION [3]	12	12	12	12	13	13	N/A
SOLID WASTE [4]	13,806	13,851	14,355	14,860	15,366	15,873	3%
WASTEWATER	4,392	4,392	4,457	4,516	4,575	4,635	1%
ENERGY [5]	15	15	17	20	23	25	11%
TOTALS	47,682	48,023	48,936	49,862	50,818	51,778	2%

[1] This projection includes only the state agency personnel.

[2] The above does not include distribution system operators. Estimates indicate that approximately 231 persons are currently employed as distribution operators, and that the demand for such operators may increase.

[3] The above does not include information on the private sector.

[4] These estimates include both public and private sector estimates; however, if the hazardous waste program is developed as proposed, staff projections for the state agency will approximately double.

[5] These estimates reflect only public sector workforce projections.

EDUCATION

Career training in environmental pollution control disciplines is available at numerous educational institutions throughout Michigan. The University of Michigan, Michigan State University, and Western Michigan University offer both undergraduate and advanced degrees in a wide array of environmentally-related disciplines including engineering, agriculture, sciences, and public health. The University of Michigan environmental curriculum is representative of the quality training available through institutions of higher education in Michigan. For example, the University of Michigan offers B.S.E. and M.S.E. degrees in Civil Engineering with concentrations in Sanitary Engineering, Environmental Engineering, Water Resources Engineering, Water Resources Sciences, Municipal Engineering, and Public Health Administration. The University also offers M.S., M.P.H., Ph.D., and Dr.P.H. degrees in Environmental and Industrial Health. Seven concentrations are options under this program.

Ferris State College, a four-year institution, offers three environmental majors: environmental health, environmental health technician, and pesticide technology. Associate degrees in environmental training programs are also available through Monroe County Community College and Bay de Noc Community College. Monroe County Community College offers an A.A.S. degree in Environmental Technology. Bay de Noc Community College in Escanaba offers a Water Pollution Control and Purification Technology associate degree program.

LEGISLATION

The environmental/energy legislation for Michigan was obtained by request from various agency personnel and through various library references. Summaries of the legislation deemed most relevant to the eight subject areas of the workforce assessment were prepared, and are included in the respective state reports. The following list of laws represents virtually all environmental legislation for the state. Only certain of the following laws were summarized; the list is presented to show, by title, the kinds of laws which have been enacted.

Environmental Protection Act of 1970

Air Pollution Control Act

Pesticide Control Act

Safe Drinking Water Act

Radiation Control Act

Resource Recovery Act

Solid Waste Management Act

Soil Erosion and Sedimentation Control Act of 1972

Water Resources Commission Act

Waterworks and Sewerage Systems Law

Cleaning Agents and Water Conditioners Act

Liquid Industrial Waste Disposal Act

Watercraft Pollution Control Act of 1970

Shorelands Protection and Management Act of 1970

Michigan Energy Act

National Environmental Energy Workforce Assessment

Phase I

MICHIGAN

State Report

STATE PROFILE

Because of its heavy concentration of manufacturing and its diversity of economic and natural resources, Michigan is one of the most important and influential states in Region V. Its population of 9,061,000 ranks it ninth in the nation, although in land area Michigan ranks but twenty-second. However, including the huge area of the Great Lakes which lies within its jurisdiction, Michigan's size increases to eleventh in the nation. It is the lakes which augment Michigan's already abundant natural resources. Lakes also assist in providing major transportation routes linking midwestern manufacturing centers such as Chicago, Detroit, Cleveland, Toledo, and Milwaukee with eastern seaports via the St. Lawrence Seaway and the Soo Locks.

Manufacturing provides by far the greatest basis for Michigan's economic strength, headed by Detroit's industrial concentration and population. Although the automobile industry dominates the state's manufacturing capability, providing the benefits and drawbacks of a single industry economy, Michigan exhibits greater diversity in manufacturing than its reputation for automobile production might indicate.

Tourism, stimulated by fishing, winter sports, and summer sports is the state's second most important economic resource. Some 18,000,000 people take recreational trips to Michigan annually. Combined with the environmental stresses of the manufacturing community, pollution and energy usage by the tourist industry is a major factor in Michigan's environmental picture.

The northern or Upper Peninsula is rich in copper and iron deposits, the mining of which provides income for a majority of Upper Peninsula residents. Mining also provides for a significant amount of environmental damage to the Great Lakes through asbestos and mine runoff into Lake Superior. Farming in both peninsulas is a relatively small portion of Michigan's economic base, and many farmers work part-time in factories to supplement their incomes.

MICHIGAN POLLUTION CONTROL AND ABATEMENT AGENCIES

Four state agencies play leading roles in the environmental programs under consideration in this report. The Department of Natural Resources administers the air, waste water, and solid waste management programs. The pesticide program is carried out by the Department of Agriculture. The Department of Public Health is responsible for the potable water and radiation control programs, and the Department of Commerce administers the energy program.

The air, waste water, and solid waste programs are situated in the Bureau of Environmental Protection of the Department of Natural Resources. The Air Quality Division has primary responsibility for the administration of Michigan's air pollution control program. Functions include surveillance and investigation of air pollution problems, air sampling, review and approval of plans and specification for air pollution control systems and issuing permits for their installation and operation, and developing a computerized statewide emissions inventory program. This Division has a professional and technical staff of 52 persons.

The Water Quality Division administers the state's water pollution control program. Management of the Construction Grants Program, enforcement and compliance monitoring of major dischargers, regulating haulers of oil and hazardous materials, coordinating the 208 planning agencies, and toxic materials monitoring are among this Division's priorities for fiscal year 1977. The Water Quality Division carries out its activities with a professional and technical staff of 79.

The Resource Recovery Division administers the solid waste management program. Its functions include carrying out consultation and control programs for refuse processing, resource recovery, transportation and disposal. Resource recovery and volume reduction are among the Division's priorities for fiscal year 1977. This Division has a staff of fourteen professionals to carry out its functions.

The Environmental Services Division of the Department of Natural Resources provides administrative, laboratory, and program support to the three divisions described above. It has a professional and technical staff of 62. A total of over 200 professional, technical, and clerical staff members are involved in the environmental programs of the Environmental Protection Branch of the Department of Natural Resources.

The Division of Water Supply of the Bureau of Environmental and Occupational Health, Department of Public Health conducts the statewide water supply program. With a professional staff of 18, the Division functions to protect public health through supervision of public drinking water systems. The state expects to request primary enforcement responsibility for the Safe Drinking Water Act in 1978, thereby requiring substantial staff expansion over the next several years.

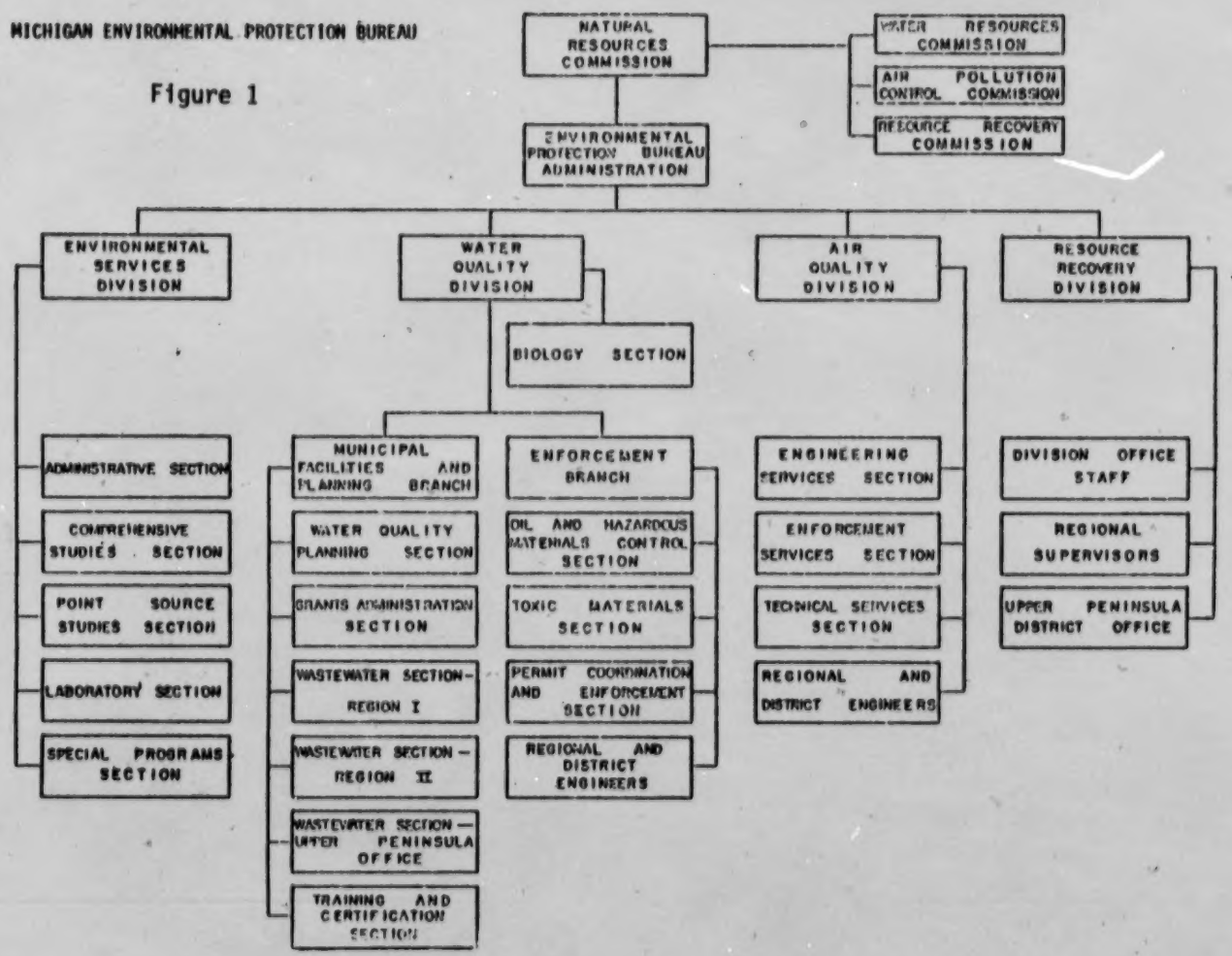
Also within the Department of Public Health, Bureau of Environmental and Occupational Health is the Division of Radiological Health. A staff of eleven professionals and technicians conduct the environmental monitoring program for radiation control, as well as licensing and control of sources using radioactive materials and electronic sources of ionizing radiation.

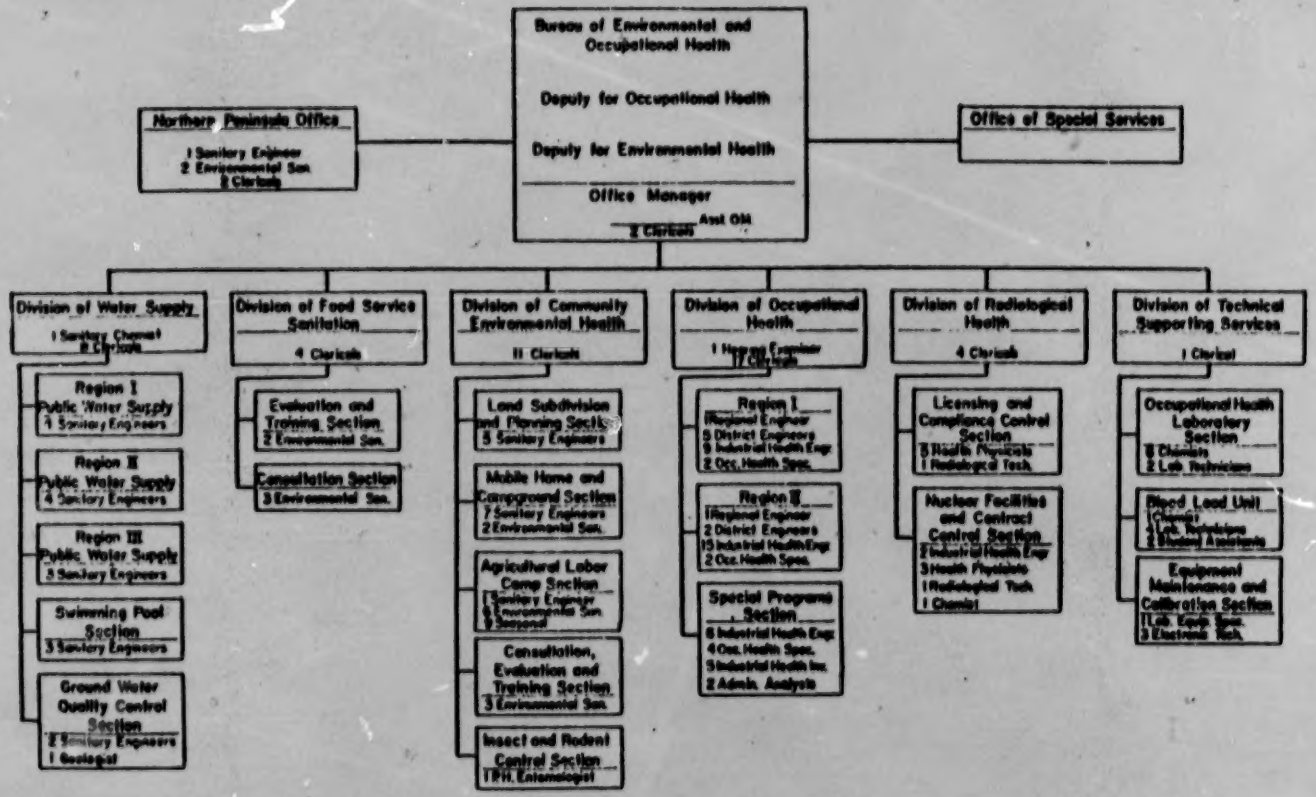
The Department of Agriculture, Plant Industry Division is responsible for certifying pesticide applicators in accordance with FIFRA and its amendments and regulating pesticide use. Its staff of agricultural scientists will devote approximately eight person-years to the pesticide control program in 1977.

Finally, the Energy Administration was created within the Department of Commerce to develop state energy policy. The emphasis of its present activities is on energy conservation. The energy program is carried out by a professional staff of fourteen.

MICHIGAN ENVIRONMENTAL PROTECTION BUREAU

Figure 1





DEPARTMENT OF PUBLIC HEALTH

Bureau of Environmental and Occupational Health

Figure 2

Pollution Control and Abatement Programs

I. AIR

A. Introduction

Because it is a highly urbanized and industrialized state, Michigan has an extensive network of state and local agencies responsible for air pollution control. The Air Pollution Control Commission, a part of the Michigan Department of Natural Resources (MDNR), is empowered to promulgate and enforce rules and regulations for the control of air pollution. The Commission also has the responsibility for encouraging voluntary cooperation of persons and industries for the abatement of air pollution and for collecting and allocating of monies from the federal government and other sources for pollution control studies and research.

Primary responsibility for the administration of Michigan's air pollution control program lies with the MDNR, Bureau of Environmental Protection, Air Quality Division. The functions of the Division, as set forth in the Bureau Directory, include the following:

1) Surveillance and investigation of air pollution problems and enforcement of Michigan's air pollution control programs throughout the state;

2) Review and approval of plans and specifications for air pollution control systems and issuance of permits to install and operate these systems;

3) Implementation and supervision of the Air Pollution Control Commission surveillance fee program;

4) Development and operation of a statewide air sampling network;

5) Liaison with local governments for the control of air pollution problems;

6) Development of a computerized statewide emissions inventory program;

7) Continuous review and appropriate action regarding state and federal legislative proposals affecting the state's air pollution program.

The initial priority for the Air Quality Division during Fiscal Year 1977 is attaining and maintaining of established air quality standards through regulation of all potential point sources. During Fiscal Year 1977, the state will seek delegation of authority to enforce regulations for eleven categories of New Source Performance Standards (NSPS) in addition to twelve sources for which it already exercises authority. Delegation of authority will also be sought for enforcement of vinyl chloride regulations, if promulgated by EPA, in addition to three classes of emissions subject to National Emissions Standards for Hazardous Air Pollution (NESHAPS) regulations. Finally, the Division will seek delegation of authority for the prevention of significant deterioration (PSD) of air resources.

The Division concentrates its resources on enforcement and compliance monitoring. Enforcement efforts include scheduled investigations, complaint investigations, and source testing.

On the local level, the Air Pollution Control Division of the Wayne County Department of Health has an active municipal air pollution control program. The Wayne County program has a professional and technical staff of 70. The major enforcement activities of the Air Pollution Control Division are as follows:

1) Responding to citizen complaints and abatement of any air pollution violations that occur within Wayne County;

2) Conducting inspections of fuel burning equipment, incineration and process control equipment;

3) Ensuring conformance with the regulations and specific emission limitations in the industrial, commercial, and domestic sectors;

4) Issuing violation notices and initiating court action as necessary to assure compliance with regulations.

The Division also administers a permit system for preventive and corrective control of equipment installations, operates a continuous program for measuring significant air contaminants and assessing community air quality, and operates a laboratory unit and mobile laboratories. New federal requirements have led the Division to include in its efforts such programs as NSPS, NESHAPS, PSD, and indirect source review.

Private industry also is active in air pollution control. Many corporations have large environmental staffs which conduct research, design and develop equipment to combat air pollution problems, as well as carry out air quality monitoring and equipment maintenance.

B. Workforce Profile

Data for the workforce profile was obtained through on-site and telephone interviews with professionals in the field in the public and private sectors. Mr. Lee E. Jager, Chief, Air Quality Division, MDNR, Mr. Morton Sterling, Director, and Mr. William Achinger, Assistant Director, Wayne County Air Pollution Control Division, Wayne County Department of Health provided valuable assistance in the collection of this data.

The operations of the Air Quality Division are carried out through the central office in Lansing and nine district offices located throughout the state. The total professional and technical staffing level is currently 52 persons. The central office is staffed by 31 professional and technical persons, and the remaining 21 persons are allocated to the district offices.

The predominating positions in the Air Quality Division are engineer and technician. Table I illustrates the staffing level, by position, of the Division.

TABLE I

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

Air Quality Division
Current (1976) Staffing Level

Position	1976
Engineer	29
Meteorologist	2
Technician	17
Other	4
TOTAL	52

The engineers have a variety of backgrounds including civil, mechanical, and chemical. Many hold masters degrees and are registered professional engineers. In fact, all engineers who supervise the district offices are required to be registered engineers, and all engineers are encouraged to become registered. Most of the technicians hold the position of air quality investigator. This position requires an electronics background for operating air quality monitors. Many of the technicians obtained electronics training in the military, are former television

repair persons, or operated electronic equipment in private industry. The "Other" category includes the Division chief, who is a registered professional engineer, an administrative assistant, an administrative analyst, and an information and education specialist. In addition, an attorney is provided to the Division by the Attorney General's office.

Laboratory support for the state air program is provided by the Laboratory Section, Environmental Services Division, MDNR. Three chemists and two laboratory technicians are involved in air analysis.

The staffing pattern for the Wayne County Air Pollution Control Division is shown in Table II.

TABLE II

WAYNE COUNTY DEPARTMENT OF HEALTH

Air Pollution Control Division
Current (1976) Staffing Level

Position	1976
Engineer	14
Attorney	2
Meteorologist	1
Scientist	6
Technician	33
Sanitarian	1
Other	12
TOTAL	69

Engineers are classified as public health engineers and are degreed civil engineers with specializations in public health, municipal or sanitary engineering. The technicians include combustion equipment inspectors, electronics technicians, and field technicians. The combustion equipment inspectors are required to have training in power plant engineering, the electronics technicians are required to have completed an

electronics engineering course from a recognized technical institution, and the field technicians are required to have completed post-high school courses in the physical sciences or in the public health field. The scientists are degreed chemists. The "Other" category includes five administrators who are degreed engineers or scientists, a publicist, a project illustrator, a data processor, two computer programmers, and an accountant.

Macomb County, Muskegon County and the City of Grand Rapids also have air pollution programs employing an estimated total of ten professional and technical personnel, that is, engineers, scientists and inspectors. The state air program and the municipal air programs, in total, have a professional and technical staffing level of approximately 140.

Public and private sector sources estimate that there may be about 1,000 engineers, scientists, and technicians involved in air pollution control work in the private sector in Michigan. Much of this workforce is employed by the electric utilities, the automobile industry, the steel industry, the pulp and paper industry, refineries, and the petrochemical industry. Professions include engineers (primarily chemical, mechanical and architectural), chemists, meteorologists, and computer specialists. Activities are carried out both by corporate environmental staffs, if the corporate headquarters are located in Michigan, and by plant engineering departments.

Corporate environmental staffs are responsible for environmental policy planning, long-range planning of facilities and equipment, conducting environmental studies, preparing environmental reports for

regulatory agencies, keeping top management informed of new rules and regulations, auditing plant performance as it relates to air pollution control, and providing technical assistance to plants in solving air pollution control problems. Engineering departments are responsible for ensuring plant compliance with air pollution control regulations, air quality monitoring, and operation and maintenance of air pollution control equipment. These departments also are responsible for interior plant conditions such as control of fumes and chemicals in accordance with OSHA regulations, as well as for control of outside air pollution caused by plant operations.

Assisting with these activities are nondegreed technical personnel. Most of the professional and technical workforce do not devote full-time to air pollution control. Rather, these personnel may be involved in other environmental control activities, and, frequently, they perform other functions that are not related to environmental matters.

Sources in the field indicate that it is often more cost-effective for a company to hire outside consultants to solve a particular air pollution problem than to augment its permanent staff. However, no estimate of the number of air pollution control consultants is available. Many corporations utilize the services of out-of-state consultants.

In filling professional positions in industry, companies tend to seek persons with experience in pollution control, who have a knowledge of environmental regulations and technology. Consequently, recruitment is often conducted through advertisements in newspapers or professional

journals, it may occur from within the company, or positions may be filled with persons recruited from governmental agencies. For technical positions, recruitment is primarily from within the company because of union regulations which require that members receive first consideration for job openings. Technicians who have electrical, mechanical, or combustion background are preferred.

In summary, field research suggests that there may be up to 1,200 professional and technical persons employed in the field of air quality control in the public and private sectors. Approximately 90 percent of the air pollution control employment is in the private sector.

C. Workforce Projections

Workforce projections represent the best professional judgment of MDNR, Wayne County Department of Health, and private sector sources.

MDNR sources indicate that significant growth will be required in the Air Quality Division over the next five years as air pollution regulations become more stringent and the Division assumes new responsibilities such as those described in the introduction. An optimum staffing increase over the next five years would be 120 persons. However, due to an anticipated insufficiency in supportive funding from both the State Legislature and the federal government, program officials fear that growth in their staff may be minimal.

The turnover rate for both the professional and technical staff is approximately 10 percent per year. Turnover has not been a problem for the Air Quality Division because it has been a growing

organization in which employees can advance in both salary and position. Therefore, so far, employees have not been hired by private industry. Sources at the Division anticipate that the turnover rate for engineers who have reached maximum salary levels may increase over the next several years because salaries are higher for engineers in private industry. The laboratory support staff for the state air program may experience a growth of approximately five chemists and laboratory technicians over the next five years.

The municipal air pollution control agencies, including Wayne County, expect minimal or no growth over the next five years. The growth of Wayne County program, the only comprehensive local program in the state, is constrained by a lack of funds. However, because many of the 27 combustion equipment inspectors and supervisors will be reaching retirement age in the next five years, there will be hiring of individuals with combustion experience to replace the retirees.

Public and private sector sources indicate that there will be little growth in the industrial air pollution control workforce. Environmental staffs were built up quickly in the early 1970s. Of the 455 major installations, 438 either are in compliance with current emission limits or they have agreed to an acceptable compliance schedule. Fourteen major installations are in violation of emission regulations, and the status of three major installations is unknown. Further plant modifications for compliance with regulations will require little additional staffing unless significant changes are made in federal regulations. Moreover, private sector sources point out that it is often less expensive to hire consultants to solve a problem than to increase

a company's staff. The consultants hired are not always headquartered in Michigan. Field research suggests that in the private sector, in aggregate, there will be an estimate 5 percent annual growth rate for the air pollution control workforce over the next five years. If growth does proceed at a 5 percent annual rate, an addition of approximately 275 persons will be added to the private sector air pollution control workforce by 1982. Specific turnover rates for the private sector are not available; however, private sector sources report that turnover is low for both professional and technical positions.

Little growth is expected to occur in the public sector. It is unlikely that the state air program will realize a significant portion of its staffing goal although the workload of the program may increase considerably. The municipal air programs are not likely to experience much growth over the next several years because of funding constraints. In the private sector, growth is projected to occur at an average annual rate of 5 percent or by a total of approximately 275 professional and technical personnel over the next five years.

D. Training and Certification

MDNR holds semi-annual visible emissions training courses for recertification of smoke readers. In October 1975 and again in May 1976, approximately 35 Air Quality Division and municipal air pollution control agency staff members were recertified. The Wayne County Air Pollution Control Division conducts its own semi-annual smoke

reading school for its field inspection staff. Air Quality Division staff members also attend EPA courses and special interest courses sponsored by Michigan State University and University of Michigan. In Fiscal Year 1976 staff members attended twelve separate short-term training courses, with a person-hour involvement of nearly 1,800 hours.

Community colleges, four-year colleges, and universities provide education in air pollution control. Among them are University of Michigan which offers a B.S.E. degree in Environmental Engineering and a Ph.D. in Environmental Health through the School of Public Health, Ferris State College, which offers an A.A.S. degree and a B.S. degree in Environmental Health, and Michigan Technological University which offers advanced degrees in environmental science and engineering. The General Motors Institute offers engineering degrees with air pollution courses available.

Both the state and local air pollution control agencies utilize EPA audio-visual training packages and indicate that additional package courses would be desirable, especially for training field technicians. Sources in these agencies suggest that these courses cover such topics as legal aspects of air pollution control, conducting installation permit reviews, calibration, and equipment maintenance. They further suggest that information, perhaps in the form of self-instructional training packages, be provided to the instructors on how to utilize the training materials most effectively.

Sources in the field also indicate that the writing skills of both professional and technical personnel are inadequate. Professionals in the private sector point out that for professional level jobs liberal arts type environmental curricula usually are insufficient preparation for environmental control positions in industry. Rather, engineers who also have solid science backgrounds are most qualified for industrial pollution control positions. Finally, private sector sources indicate that college and university engineering curricula should place more emphasis on the environmental aspects of engineering.

E. Career Potential

Experts in the field do not anticipate the development of new or unique careers in air pollution control. However, some opportunities should be available in the public sector because of the small amount of growth that might occur in the state air program and the anticipated retirement of personnel in the Wayne County air program. Public sector career opportunities will be primarily for degreed engineers and technicians who have electronics or combustion experience. Field research suggests that jobs may be increasing in air pollution control in the private sector at an approximate rate of 55 positions per year for professional and technical personnel combined. However, private sector sources report that when technicians or engineers are required for air pollution control work, company employees often are selected and then trained for the particular job. This is especially true for

technician positions because of union regulations. Professionals in the field point out that a need exists for highly trained engineers and scientists to conduct research in air pollution control in the universities and in private industry. The workforce implications of this need will depend upon the amount of money allocated for such research. Over the past several years funding for this purpose has been quite restricted. It should be noted that workforce growth in air pollution control is expected to be relatively low over the next several years, thereby limiting career potential.

F. Conclusion

Although some growth in the air pollution control field is anticipated, it is expected to occur at a relatively slow rate, approximately 5 percent per annum in the private sector. Workforce growth is limited in the public sector because of state and local budgetary constraints. In the private sector, most firms have fairly well-staffed environmental components. Economic growth could increase the air pollution control workforce, but the depressed economy of the state does not portend the large scale development of new industry.

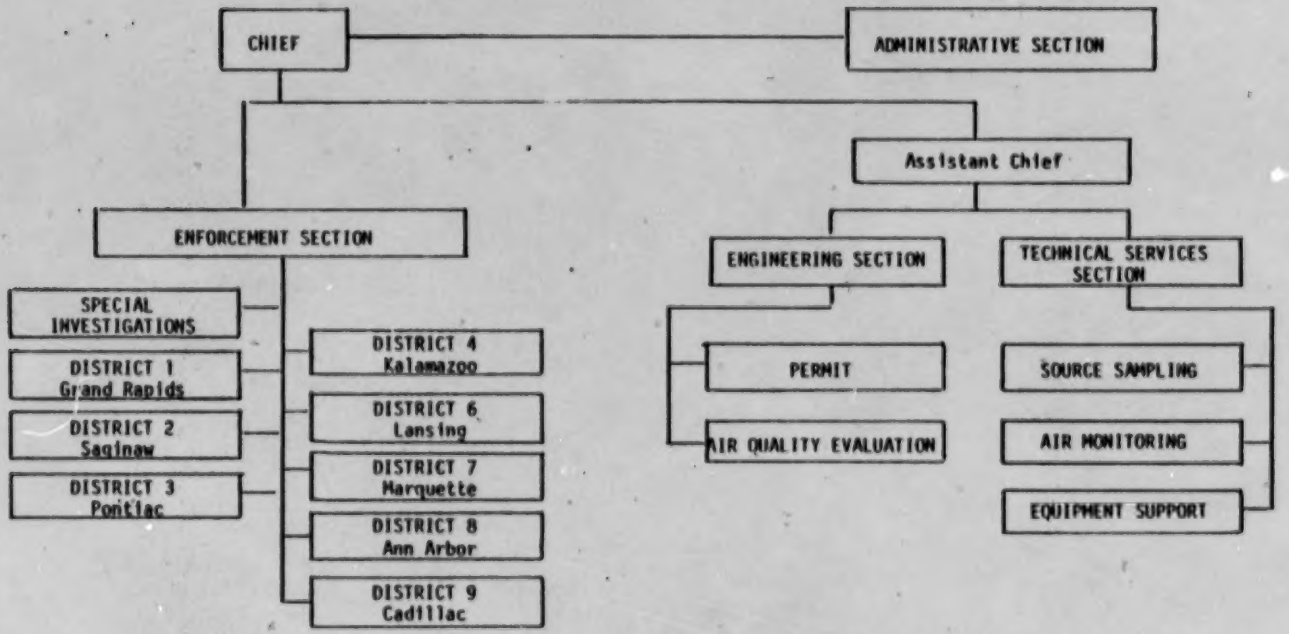
At present, the field is staffed primarily with engineers, chemists, meteorologists, attorneys, and technicians who have experience in electronics and combustion. Because the field is growing slowly, public and private sector sources do not recommend that vocational/technical institutions implement specific curricula to train air pollution control

technicians. However, sources in the field do point out that training needs, in particular for upgrade of technicians, do exist and funds for this purpose, especially in the municipal air pollution control agencies, are limited. They recommend, therefore, that more self-instructional short courses be developed by EPA and that technical institutions offer appropriate short courses. These methods of training have proven to be effective. Moreover, they allow training to be accomplished at or near the work location, thus reducing travel costs and time lost from the job. Finally, professionals in the private sector indicate that traditional engineering curricula should provide more emphasis on the environmental aspects of engineering.

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

Air Quality Division

Figure 3

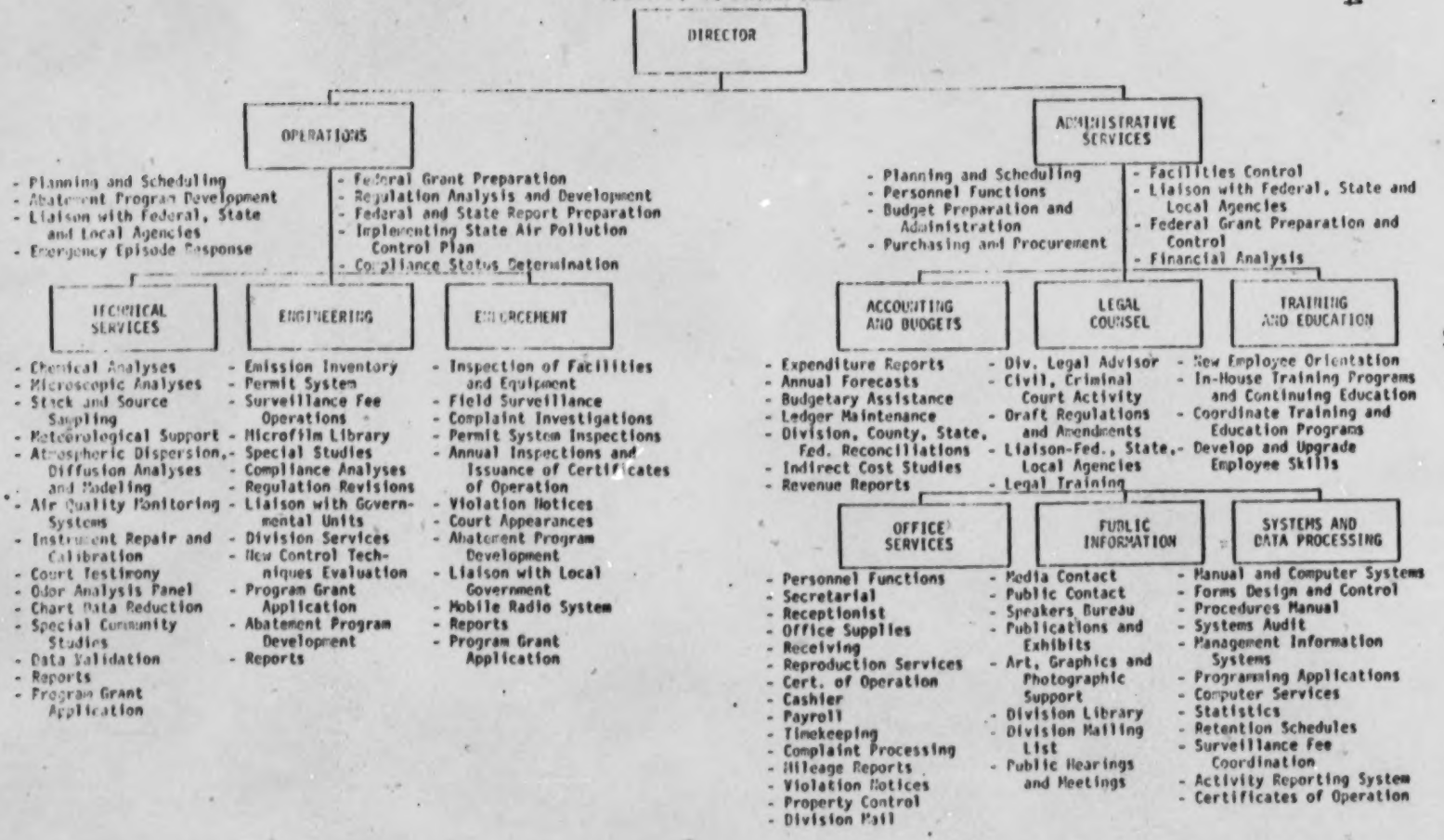


WAYNE COUNTY HEALTH DEPARTMENT

Air Pollution Control Division

Figure 4

FUNCTIONAL ALLOCATIONS CHART



II. NOISE

A. Introduction

Michigan has no noise legislation on the state level, and activities in environmental noise control are quite limited. The state agency most active in control of environmental noise is the Michigan Department of State Highways and Transportation. This agency responds to public complaints concerning excessive vehicular noise and takes corrective action through the design of noise barriers. The Department also conducts noise studies to be included in Environmental Impact Statements for new construction projects. This Department has attempted to introduce a bill into the state legislature to control vehicular noise. However, the strength of the automobile industry in Michigan has prohibited the passage of such a bill. Sources at the Department indicate that they will be addressing the problem of highway construction noise through the development of regulations which will require the installation of mufflers on highway construction equipment and which will regulate the hours of permitted operation. The Michigan Department of Public Health also conducts noise control activities. They include enforcing OSHA regulations and those pertaining to construction noise. Other noise control activities in the state include research conducted at Michigan State University, activities of municipalities through local noise ordinances, activities of private industry for industrial noise abatement, and vehicular noise abatement research and development by the automobile manufacturers.

B. Workforce Profile

Information for the workforce profile was obtained through on-site and telephone interviews with professionals in the public and private sectors. Two separate divisions of the Michigan Department of State Highways and Transportation are involved in noise control and abatement, the Environmental and Community Factors Division and the Testing and Research Division. In the Environmental and Community Factors Division, two staff members devote about fifteen percent of their time to writing the noise portion of Environmental Impact Statements. One of these persons is a civil engineer, and the other is a technician. In the Testing and Research Division, three civil engineers and one technician work full-time to respond to public complaints concerning noise. Response to noise complaints involves such activities as field measurement, computer modeling and barrier height determination.

The OSHA industrial noise control program is regulated by the Michigan Department of Public Health, Bureau of Occupational and Environmental Health, Division of Occupational Health. This Division has an authorized staff of 50 people, mostly industrial health engineers, which spends a small portion of its time on monitoring and enforcement of industrial noise control regulations. Also involved in control of industrial noise are persons within industry. These persons are often industrial hygienists for whom noise control is frequently an adjunct to other industrial health activities.

Nineteen cities have municipal noise ordinances. The cities and the types of ordinances are shown in the table below. This table is adapted from Sound and Vibration, December, 1975.

TABLE III

STATE OF MICHIGAN

Municipal Noise Ordinances

City	Nuisance	Zoning	Vehicle	Rec/Vehicle	Railroad	Aircraft	Construction	Building
Ann Arbor	0	X	X	-	-	-	-	0
Augusta Twp.	0	-	-	-	-	-	-	-
Beverly Hills	0	-	-	-	-	-	-	-
Birmingham	0	-	X	-	-	-	-	-
Comstock	X	-	X	X	-	-	-	-
Dearborn	0	-	-	-	-	0	-	-
Detroit	0	-	-	-	-	-	-	-
Farmington	0	-	-	-	-	-	-	-
Grand Rapids	X	X	X	X	-	-	X	X
Kalamazoo	0	X	X	X	X	-	X	-
Meridian Twp.	X	X	X	X	-	-	-	-
Milford	-	X	-	-	-	-	-	X
Pontiac	0	X	-	-	-	-	-	-
Ravenna	0	-	-	-	-	-	-	-
Saginaw	0	0	0	-	0	-	0	-
Troy	0	-	-	-	-	-	-	-
Warren	0	X	0	-	-	-	-	-
Westland	X	X	-	-	-	-	-	-
Wyoming	0	-	-	-	-	-	-	-

X denotes that regulation includes acoustical criteria
0 denotes that regulation does not include acoustical criteria
- denotes no regulation

These ordinances are usually enforced by local law enforcement authorities. The omission of acoustical criteria means that the regulations are nonquantitative and, therefore, difficult to enforce. Field research suggests that these noise ordinances are not being actively enforced and, furthermore, that no communities in the state have active noise control programs.

Research and development activities are being conducted by highly trained engineers and scientists in the automobile industry to develop methods of noise reduction in medium and heavy trucks, as

well as in automobiles. Sources in the field indicate that there are at least 50 persons in the automobile companies working in this area. These persons tend to be involved in other activities and work in noise control on a part-time basis. Their backgrounds are primarily in acoustical, mechanical, and electrical engineering and physics.

Michigan State University faculty members also conduct occasional research into abatement of highway noise in conjunction with the Michigan Department of State Highways and Transportation.

In summary, there appears to be a relatively small workforce employed to control highway and industrial noise. Many of these people have backgrounds in engineering or physics and are involved in noise control on a part-time basis.

C. Workforce Projections

Sources at the Department of State Highways and Transportation expect no growth in their staff or in the time spent on noise control activities. According to these sources, even if the workload in noise control increases, computer modeling techniques have been perfected which allow the work to be carried out by a minimal workforce. No growth in staff devoted to noise control activities in the Department of Public Health is expected to occur, either, since control of noise is not a priority program.

Currently, environmental noise pollution control is not recognized as a distinct professional area and public interest in noise control remains at a relatively low level. Sources in the field expect that as federal regulations regarding noise become more

stringent and as public awareness increases, growth will occur in the workforce involved in noise control on both the professional and technical levels. However, field sources could not provide specific workforce projections.

D. Training and Certification

Little training is available in the state in any aspect of noise control and abatement. Michigan State University and the University of Michigan, as well as some colleges and community colleges in the state, offer noise-related topics as part of engineering or environmental survey courses. Field research indicates that no programs or courses exist which emphasize methods of noise control and abatement.

E. Career Potential

Workforce growth in noise pollution control appears to be limited over the next several years, but several noise-related occupations may develop slowly. Growth is projected to occur in such activities as predicting noise levels, writing noise legislation, developing quieter mechanical devices for both industry and the home, enforcing noise ordinances, measuring noise levels, and maintaining equipment used to control and measure noise. Professional level training in engineering, science, and law will be necessary for persons involved in equipment design and development, research, noise level prediction and development of legislation and regulations. Community colleges and vocational/technical institutions can provide training for personnel in technical

positions. Technical positions may include enforcement, monitoring and equipment maintenance.

F. Conclusion

Although noise control activities in Michigan are presently restricted, development in this area can be expected to occur as federal regulations become more stringent and as public cognizance of the fact that noise can be controlled increases. These factors will promote an increase in the demand for engineers, scientists, and attorneys, as well as for persons with appropriate technical training for enforcement, monitoring, and equipment maintenance. As development in this field progresses, program development and upgrade/enrichment courses will be necessary for persons involved in noise control in both professional and technical capacities.

III. PESTICIDES

A. Introduction

Michigan passed the Pesticide Control Act of 1976 which, effective in June of 1976, put the state in compliance with FIFRA and its amendments. Prior to this time, Michigan had a pesticide registration law, an applicator law, and a regulatory program which required pesticides sold or distributed within the state to be registered with the Director of the Michigan Department of Agriculture and certain pesticide formulations to be sold only by licensed dealers. Dealers of restricted use pesticides were required to pass a written examination and to renew their licenses annually, and commercial applicators were required to obtain an annual license. Until 1970, the law regulated only outdoor applicators. Amendments were passed in 1970 to include indoor applicators. The amendments also required new applicants after January 1971 to pass a written examination and required commercial applicators to furnish proof of financial liability and a surety bond.

The Pesticide Control Act of 1976 combines the registration law and the applicator law into one act and includes provisions for the certification of commercial and private applicators as required by federal law. The revised pesticide law makes it illegal to hold oneself out in the business of applying pesticides without a license. Therefore, it is not necessary to prove that an applicator applied pesticides to show he/she violated the law.

The Michigan Department of Agriculture is the state lead agency for the pesticide applicator certification program. Within the Department of Agriculture, the Plant Industry Division is responsible for administering and implementing the program. Other agencies cooperating in the state certification program are the Michigan State Cooperative Extension Service, the Michigan Department of Natural Resources, and the Michigan Department of Public Health.

The former pesticide applicator law created the Pesticide Advisory Committee to consult with and advise the Director of the Department of Agriculture in the administration of the Act. The Committee is composed of the Directors of the Department of Natural Resources, Public Health, Bureau of Aeronautics, Cooperative Extension Services and the Executive Director of the Water Resources Commission. The Pesticide Control Act of 1976 provides for six additional members to be appointed by the Director of the Department of Agriculture must represent the following: licensed commercial applicators, producers of agricultural commodities, nongovernmental organizations for environmental preservation, farm laborers, those in the medical profession experienced in the toxicology of pesticides, and the agricultural chemical industry.

B. Workforce Profile

Workforce profile data was collected through on-site and telephone interviews with professionals in the field of pesticides. Of particular assistance was the chief of the Plant Industry Division, Department of Agriculture.

The Plant Industry Division (PID) is responsible for administering and implementing the state certification plan and conducting regulatory

activities, as well as for enforcing laws and regulations designed to prevent the introduction and spread of plant diseases. Regulatory activities with regard to pesticides include market surveillance and investigation of misuse of pesticides and complaints of pesticide injury. The PID also monitors licensed dealers, certified applicators, pesticide storage and disposal methods and experimental permits, and samples pesticides in the market and tank mixes of applicators.

The PID has a professional staff of 70. Staff members spend between five and one hundred percent of their time on the state pesticide program. Approximately one-fifth of this staff operates out of the headquarters in Lansing, while the rest of the staff is located in the six field offices around the state. Staff positions are as follows: one chief, one assistant chief, two staff assistants, one registration supervisor, six regional supervisors, six pesticide specialists, and 53 inspectors. All of these staff members have at least a bachelor's degree with specializations in entomology, plant pathology, horticulture, biology, agriculture, botany, or forestry. In total, an estimated eight person-years will be allocated to the pesticide program in 1977.

The Michigan State Cooperative Extension Service (MCES) is responsible for developing the applicator certification training programs. The MCES has appointed a State Pesticide Coordinator who is responsible for the day-to-day activities associated with developing these programs. MCES has, in addition, nine primary specialists involved in developing the training programs. The primary specialists represent the following departments of Michigan State University: Entomology, Horticulture,

Botany and Plant Pathology, Fisheries and Wildlife, Argicultural Engineering, Forestry, Crops and Soil Science, Animal Husbandry, and Veterinary Medicine. In most cases, the primary specialists will be assisted by three to five other persons within their departments. In total, about 35 MCES personnel are involved in the pesticide program.

Seven persons work in insect and rodent control and pesticide research in the Michigan Department of Public Health. Their functions include providing training, technical assistance, and consultation to local health departments, other state agencies, municipalities, and citizens in the operation of organized programs for control of pests of public health significance and the proper use and disposal of pesticides.

The Michigan Department of Natural Resources, Environmental Services Laboratory has a staff of two chemists and one laboratory technician in pesticides.

The Department of Agriculture estimates that there are approximately 2,040 commercial applicators in the state and up to 25,000 private applicators who will require certification to achieve the requirements of federal and state legislation. Farmers producing fruits, vegetables, and specialty crops will comprise the majority of private applicators who require certification.

The total estimated pest control workforce picture is reflected in the following table in which figures are approximations of the workforce engaged in pesticide use or control on either a full- or part-time basis.

TABLE IV

STATE OF MICHIGAN

Public and Private Sector Pesticide Workforce
Current (1976) Staffing Level

Public Sector		1976
Department of Agriculture		70
MSU Cooperative Extension		35
Department of Public Health		7
Department of Natural Resources		3
	TOTAL	115
Private Sector		
Farmers		25,000
Owners/Operators/Applicators		2,040
	TOTAL	27,040

In sum, there are over 100 public sector professional and technical personnel involved in pesticide usage and pest control practices. Their activities include inspection, enforcement, training, advising, and laboratory analysis. In the private sector, over 27,000 persons are engaged in the application of restricted use pesticides. It should be noted that the private sector portion of the above table underestimates workforce levels since it omits figures concerning crew size for commercial applicators. As of September 1976, 850 commercial applicators had been licensed.

C. Workforce Projections

Workforce projections are based on the best professional judgment of professionals in the field. PID sources indicate that the Division will require an increase in staffing of between ten and fourteen people to comply with FIFRA and the Pesticide Control Act of 1976. In

the past year, four persons were added to the staff to assist with the certification program. Persons with a minimum of a bachelor's degree in entomology, plant pathology, horticulture, biology, agriculture, botany or forestry will be recruited for these positions. Over the next five years, then, the PID staff will increase at an average per annum rate of not more than four percent. Turnover among the PID staff is approximately six percent per year.

Sources in the field estimate that there may be a ten percent per annum increase in the number of commercial applicators over the next five years. This growth will occur as a result of the certification requirement for application of restricted use pesticides. Some farmers and operators of commercial establishments who formerly applied their own pesticides are expected to hire commercial applicators rather than go through the process of certification themselves. Sources in the field indicate that the increase will be in the number of applicators who apply pesticides outdoors rather than structural applicators since the market for structural applicators already is saturated in many areas of the state. If the annual growth rate for commercial applicators is ten percent, the number of commercial applicators will increase by approximately 1,200 over the next five years, and the total number of commercial applicators will be about 3,200 by 1982.

D. Training and Certification

In the PID, one plant industry inspector in each of the six field offices was selected to be a key pesticide resource specialist. These inspectors receive periodic training from the PID. The PID also provides a three to four day training conference each year for all professional and technical staff and offers specialized sessions as the need arises. New entrants serve as on-the-job trainees for two years before acquiring the status of qualified inspector.

The MCES has developed self-instructional manuals for applicator training. Supplementary training is provided to commercial applicators by the PID pesticide specialists and to private applicators by county extension agents. If it is found that this method does not provide adequate training, the MCES will offer additional training sessions.

Michigan State University offers a series of pest management courses which are provided inter-departmentally by the College of Agriculture and Natural Resources and the College of Natural Science. Ferris State College has a pesticide technology program which offers an A.A.S. degree and an environmental planning and management program with a vector control option which offers a B.S. degree. Graduates of the pesticide technology program often become pest control operators, while graduates of the environmental planning and management program often become managers, supervisors, or consultants in various aspects of chemical and environmental pest control.

E. Career Potential

Sources at the Department of Agriculture indicate that there is a need for people with special training to work in regulatory agencies. Not only is an agricultural science background necessary, but regulatory personnel also require a diverse knowledge concerning the operation of agribusiness. Sources in the field indicate that sanitarians are assuming increasing importance as a result of more stringent pesticide regulations. Sanitarians usually require a degree in science and act in such capacities as consumer safety officers and inspectors. Since the commercial applicator field is expected to increase over the next five years, career potential may be available for applicators, operators, and equipment mechanics, as well as for sanitarians. Jobs are also available for trained and certified applicators in the food processing industry to control rats and insects.

Field research suggests that integrated pest management will assume increasing importance over the next several years. Because of increasingly stringent regulations governing the use of pesticides and growing public sentiment against the use of chemical pest control in agriculture, some commercial applicators have begun to establish environmental control branches designed to decrease the use of chemical controls and sprays. Accordingly, career opportunities are developing for consultants who have training in integrated pest management. In addition, there may be opportunities at the technical level for people with short course backgrounds.

F. Conclusion

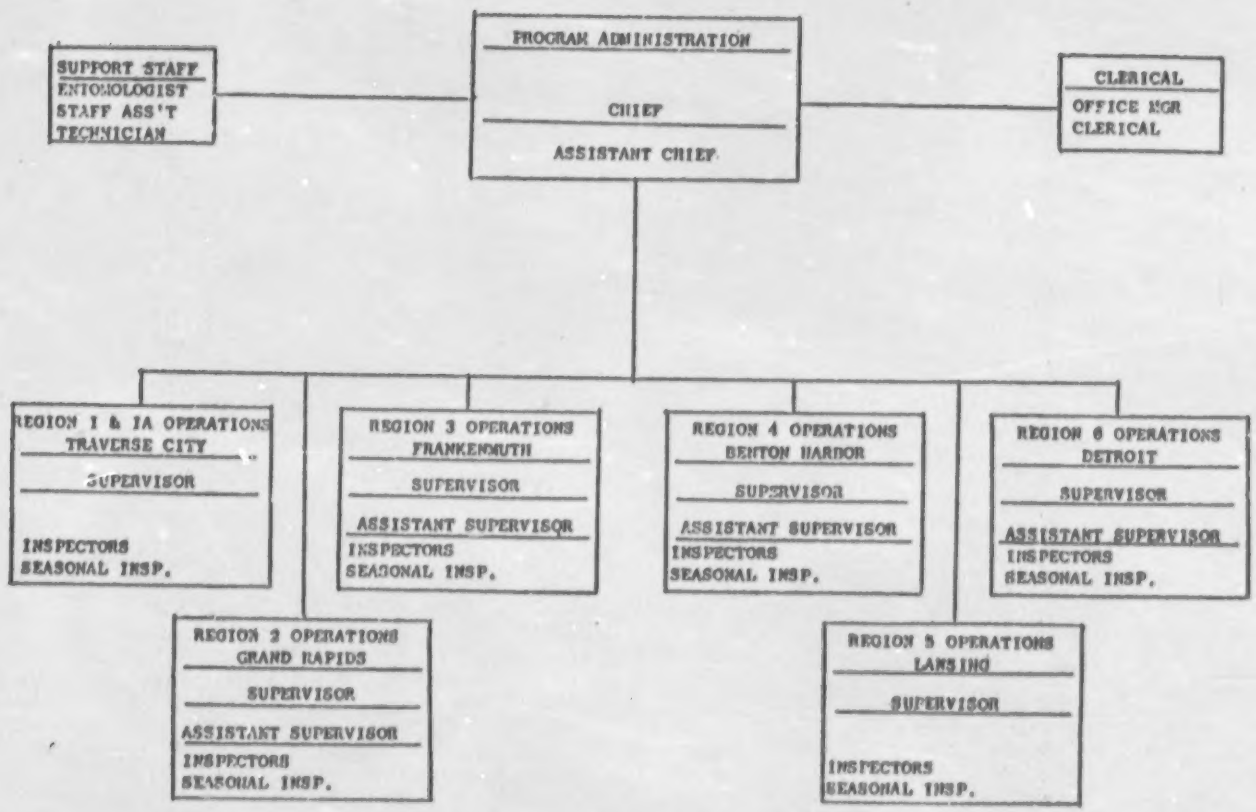
The foregoing suggests that the greatest area of job opportunity will be in commercial applications and integrated pest management. Expansion of the commercial applicator field is expected to result from more stringent regulations which require that applicators of restricted use pesticides be certified. Sources in the field indicate that expansion will occur more for outdoor applicators than for structural applicators since there may already be an oversupply of structural applicators in the state. Job openings may develop for applicators, operators, equipment mechanics, and sanitarians. The PID expects to increase its staff over the next five years as a result of expanded activities under FIFRA and new state legislation. However, this increase will total only about ten to fourteen persons.

Although integrated pest management is in a relatively early stage of development, the use of IPM techniques are likely to become increasingly widespread as federal and state pesticide regulations become more stringent, public awareness grows, and additional research becomes available. Consequently, the demand for trained personnel is likely to develop, and both universities and vocational/technical institutions may find a market for graduates trained in Integrated Pest Management.

MICHIGAN DEPARTMENT OF AGRICULTURE

PLANT INDUSTRY DIVISION

Figure 5



IV. POTABLE WATER

A. Introduction

Michigan has approximately 830 community water supplies. There are three filtration plant and operator certification classifications based on the amount of water handled each day or the population served. Categories are as follows: F-1) less than five million gallons per day or less than 40,000 population; F-2) one to five million gallons per day or 4,000 to 40,000 population; F-3) less than one million gallons per day or less than 4,000 population. Licenses are also issued for disinfection and are based on water flow or population as follows: D-1) one million gallons per day or greater than 4,000 population; D-2) less than one million gallons per day or less than 4,000 population. Finally, there are six miscellaneous classifications of plants and licenses based on the type of treatment carried out. These classifications are phosphate, zeolite, iron removal, fluoridation, diatomite filtration, and laboratory. These licenses are held by operators who do not hold an F certification.

Michigan has a mandatory operator certification program for community-type water system operators where treatment is involved. All community systems must be under the supervision of at least one operater certified at the appropriate or higher plant classification. Distribution system operators are certified on a voluntary basis with certification based on the size of the population served: S-1) greater than 40,000 population; S-2) 4,000 to 40,000 population; S-3) less than 4,000 population.

The Michigan Department of Public Health, Bureau of Environmental and Occupational Health, Division of Water Supply is the primary state agency responsible for the potable water program. During Fiscal Year 1977, high priority will be given to developing a program of public water supply in conformance with the Safe Drinking Water Act. It is anticipated that Michigan will formally request delegation of primary enforcement responsibility in 1978. Under the new federal definition of a public water supply, an estimated 18,000 non-community supplies may be added to the jurisdictional responsibility of the Division.

Most of the population of Michigan obtains its drinking water from the Great Lakes and their connecting waterways. A large number of water supplies use ground water as a source. Both of these water supply sources are generally of excellent quality, although in a few areas localized groundwater contamination has occured from onland disposal of wastewater, accidental spills of contaminants, and improperly designed and maintained landfills. Some groundwater in the state contains troublesome quantities of methane or hydrogen sulfide gases. A few community water supplies use Lake Superior as a water source and have provided adequate water supplies with chlorination being the only treatment employed. The Department continues to monitor these supplies closely to make certain they continuously provide a potable supply to the consumer as well as comply with the Federal Primary Drinking Water Standards. If they do not, filtration

will be required. The Department will also have to determine the number of non-community water supply systems with surface water sources that will require filtration. Department sources anticipate that the cost of upgrading non-community water supplies for compliance with federal and state laws may cause problems during the implementation of the water supply program in Michigan.

B. Workforce Profile

Data for the workforce profile was obtained through on-site and telephone interviews with professionals in the field. Department of Public Health provided valuable assistance in the collection of this data.

The basic objective of the Division of Water Supply for Fiscal Year 1977 is to develop administrative procedures for the expanded water supply program. Priority activities to this end include the following:

1) Enacting new public water supply legislation to modify and expand Michigan's existing authority to conform with the requirements of the Safe Drinking Water Act.

2) Developing administrative rules pursuant to the authority of the new legislation.

3) Reviewing state and local laboratory capabilities and expanding a statewide laboratory certification program.

4) Increasing the Division and State Laboratory surveillance staff for monitoring and surveillance of public water supplies.

5) Assuring that the State Laboratory is capable of performing all functions required by federal regulations, special surveys, and laboratory certification.

6) Developing a data management system with regard to water quality records and the inventory system for the more than 18,000 public water supply systems.

7) Beginning the inventory of all public water supply systems in Michigan.

8) Expanding education and training to all suppliers of water.

9) Developing necessary procedures in cooperation with the Department of the Attorney General for enforcing the expanded program.

The Division of Water Supply carries out its activities through its headquarters in Lansing for the lower peninsula and its office in Escanaba for the Upper Peninsula. The Division presently has a professional staff of eighteen as shown in Table I below.

TABLE V

MICHIGAN DEPARTMENT OF PUBLIC HEALTH

Division of Water Supply
Current (1976) Staffing Level

Position	1976
Engineer	15
Chemist	1
Other	2
TOTAL	18

The engineers hold the position of sanitary engineer, all have master's degrees in engineering, and most are registered professional engineers. The chemist acts as the training and certification officer. The "Other" category includes the Division chief and a program coordinator.

Table VI illustrates the distribution among the three classifications of the 298 treatment plant operators who are certified to operate filtration plants. These plants handle surface water supplies and complete lime-soda softening plants utilizing well water as a source.

TABLE VI

STATE OF MICHIGAN

Current (1976) Michigan Certified
Water Treatment Plant Operators
(Filtration Plants Only)

Classification	1976
F-1	88
F-2	86
F-3	124
TOTAL	298

Operator certification categories for filtration systems are based on the amount of water handled daily or the size of the population served. The F-1 category has the most stringent experience and education requirements, and the F-3 category has the least stringent requirements. The certification requirements include successful completing of a laboratory examination.

Certification for disinfection is based on amount of water flow or size of the population served. Certification for the miscellaneous treatment categories is based on the type of treatment carried out, with treatment types not being mutually exclusive. That is, an operator may hold more than one license depending on plant treatment capability. Therefore, the following table shows the number of licenses issued, a number greater than the total number of operators holding licenses.

TABLE VII

STATE OF MICHIGAN

Current (1976) Licenses Issued by Type of Treatment
(Groundwater Systems Only)

Classification	1976
Disinfection:	
D-1	299
D-2	120
Miscellaneous:	
Phosphate	149
Zeolite	25
Iron Removal	86
Fluoridation	197
Diatomite Filtration	15
Laboratory	61
TOTAL	952

Thus, 298 operators hold licenses to operate filtration systems and additional operators hold disinfection and miscellaneous licenses. Morever, 576 operators hold licenses but are no longer practicing.

Table VIII illustrates the number of distribution system operators, by classification, who have become certified under the voluntary program which has been in effect for four years. The classifications are based on the size of the population served. The S-1 category has the most stringent experience and education requirements and the S-3 has the least stringent requirements.

TABLE VIII

STATE OF MICHIGAN

Current (1976) Michigan Certified Water Distribution System Operators (Voluntary Program)

Classification	1976
S-1	51
S-2	54
S-3	126
TOTAL	231

Two hundred and thirty-one distribution system operators are certified under the voluntary program. No information is available concerning the total number of distribution system operators. Sources at the Division anticipate that the certification program for distribution system operators will become mandatory in 1977.

Laboratory analysis is conducted by the State Public Health Laboratory and by approximately 110 additional laboratories including those at filtration plants, public health and private laboratories. Most laboratory testing is done by a certified operator or an assistant. In the State Public Health Laboratory, approximately 16 person-years per year are devoted to laboratory analysis. This includes the efforts of chemists, microbiologists, laboratory technicians, and laboratory assistants.

Field research suggests, then, that there are over 1,000 professional and technical personnel employed at the community water supplies in Michigan as treatment and distribution system operators. There may be several hundred additional persons employed at these systems in administrative, laboratory, labor and maintenance positions. In addition, more than 30 professional and technical personnel are employed in the state water supply regulatory program. The position of sanitary engineer predominates the state program staff.

C. Workforce Projections

Workforce projections represent the best professional judgment of sources in the field. The full implementation goal for the Division of Water Supply staff to carry out the mandate of the Safe Drinking Water Act is 113 professional and technical personnel. Workforce projections, by position, for the Division are shown in Table IX.

TABLE IX

MICHIGAN DEPARTMENT OF PUBLIC HEALTH

Division of Water Supply
Workforce Projections to 1982 (est.)

Position	1976	1977	1978	1979	1980	1981	%/annum turnover (average)	%/annum growth (average)
Engineer	15	20	28	40	52	52	10%	30%
Chemist	1	1	1	2	2	2	n/a	20%
Sanitarian	0	3	24	36	48	48	n/a	216%
Other	2	5	9	10	11	11	n/a	47%
TOTAL	18	29	62	88	113	113		49%

The "Other" category includes such positions as Division chief program coordinator, cross connection control supervisor, quality surveillance supervisor, data management supervisor, attorney, training officer, hydrogeologist, grant control officer, compliance supervisor, and graphic artist. The district offices will be staffed with engineers and sanitarians, although the number of each is still uncertain. Note that the 216% per annum average growth projected for sanitarians exaggerates the magnitude of expected growth for this position since the percentage was calculated from a 1976 base of zero. Whether or not the large staffing increase shown in Table IX is realized depends upon the availability of state and federal funds. When Michigan receives primary enforcement responsibility, the Division may contract with local health departments for additional services such as public water supply inventories, routine monitoring, sample collection, and some aspects of public notification.

The State Public Health Laboratory staffing devoted to drinking water is expected to double in the next five years as a result of the increased activities necessitated by the assumption of primacy for the Safe Drinking Water Act. Accordingly, approximately 32 persons may be involved in water supply in 1982 in the positions of microbiologist, chemist, laboratory technican, and laboratory assistant.

Proposed state legislation to allow Michigan to assume primacy for the Safe Drinking Water Act includes a provision requiring filtration plants to have a certified operator for each shift.

Currently, only one operator per system is required to be certified at the grade of the plant. This provision will lead to an increase in demand for certified operators. Field research suggests that over the next five years growth in the number of certified operators in the F-1 and F-2 categories will occur at an average annual rate of 8%. the F-3 category is projected to grown at an average annual rate of 10%. New operators are generally certified at the F-3 level and then may upgrade as they satisfy the requisite experience and knowledge requirements. Workforce projections for certified filtration treatment plant operators, by classification, are shown in Table X.

TABLE X

STATE OF MICHIGAN

Water Treatment Plant Operators
Workforce Projections to 1982 (est.)

(Filtration Plants Only)

Classification	1976	1977	1978	1979	1980	1981	%/annum turnover (average)	%/annum growth (average)
F-1	88	95	103	111	120	130	n/a	8%
F-2	86	93	100	108	117	126	n/a	8%
F-3	124	136	150	165	182	200	n/a	10%
TOTAL	298	324	353	384	419	456		9%

Over the next five years, then, approximately 158 new treatment plant operators will be certified for filtration systems. Approximately half of the growth will occur in the F-1 and F-2 categories, with the other half expected to occur in F-3, the entry-level category. It should be pointed out that the increase in numbers of certified operators does not necessarily represent new employment since existing unlicensed operators will be encouraged to become

certified. Sources in the field could not provide specific estimates of turnover rate among certified operators. However, it is suggested that in the higher classifications average annual turnover may be five percent or less and in the lowest classification, F-3, turnover may be up to 20%. Turnover rates tend to be high in the entry-level classification because of low salaries and limited opportunity to upgrade in position or salary in the smaller systems. Upgrades from F-3 to F-2 tend to occur at a rate of between 12 and 20 operators per year and from F-2 to F-1 at a rate of between 6 and 10 operators per year.

The proposed state legislation requires that every distribution system have an operator certified at the grade of the system. Thus, a mandatory certification program for distribution system operators will be implemented. Division officials estimate that once Michigan assumes primary enforcement responsibility for the Safe Drinking Water Act, between 1,300 and 1,400 community supplies will require certified distribution system operators. Again, many existing unlicensed operators will become certified. Sources in the field expect a net increase in the number of operators but could not make specific estimates. Additional disinfection (D) licenses are expected to be issued as a result of the Safe Drinking Water Act, but sources in the field could not make specific workforce projections for this category of operator.

In summary, both the State Public Health Laboratory and the Division of Water Supply will require substantial staffing growth to comply with the requirements for accepting primacy for the Safe

Drinking Water Act. Specifically, the Division will require a 49% per annum average growth over the next five years, that is, growth from 13 to 113 professional and technical staff members between 1976 and 1981. The State Public Health Laboratory may double the amount of effort devoted to the drinking water program from 16 person-years in 1976 to 32 person-years by 1981. However, it is not yet certain that funding for all these state agency positions will be forthcoming from the State Legislature and federal government. The Division plans to augment its own staff capability by contracting for services from local health departments, if necessary. The community water supply systems are currently well staffed, but will require an increase in the number of certified treatment and distribution system operators if proposed state legislation becomes law.

D. Training and Certification

The surveillance staff of the Division of Water Supply has, in the past, provided operator training. In calendar year 1975, 2,040 persons obtained 2,448 person-days of training in such subjects as water hydraulics, distribution system operation, water chemistry and bacteriology, basic mathematics, and cross connection control. The Division has recently hired a chemist to work specifically on training and certification. The training effort will be expanded to meet the increased need that will be brought about when primacy for the Safe Drinking Water Act is assumed. At that time, certification will be mandatory not only for operators of community-type water supply

systems but also for operators of those non-community systems where treatment of water supply is carried out for health-related reasons. In addition, filtration plants will require an appropriately certified operator on each shift.

The Division, then, expects to expand the training program to include personnel of non-community type public water supplies and to certify more operators. Training will be provided in ground water protection, treatment technology, distribution system operation, sample collection, and cross connection control. Considerable additional staff expansion will be required for this purpose as well as for certification of new operators. Since substantial staff expansion is anticipated, in-house training will be an important and continuing part of the Division's agenda. The Division also works with U.S. EPA, the Michigan Section of the American Water Works Association, community colleges, universities, and local suppliers of water to develop and manage training programs for water supply treatment plant and distribution system operators.

One element of this training is annual 12 week courses in chemistry, hydraulics, and mathematics. These courses are conducted one night each week at about 18 locations, usually community colleges, around the state. This training alternates annually between water supply and waste water instruction and is attended by between 120 and 200 persons each year. Also available are annual three-day courses given at one of the major state universites in water bacteriology and chemistry.

In 1976, approximately 75 persons attended this training which was held at Michigan State University.

Bay de Noc Community College and Northern University Skills Center offer environmental health water/wastewater curricula, and several universities offer environmental engineering degrees. The University of Michigan offers a M.S.E. degree in public works administration.

E. Career Potential

The foregoing suggests that there will be a limited number of positions available both at the professional and technical levels for those entering the potable water field. Engineers and sanitarians will be extensively utilized by the Division of Water Supply if staffing levels approach projected workforce needs for compliance with the Safe Drinking Water Act. Specifically, the Division would like to hire approximately 85 engineers and sanitarians for the water supply program. Sources in the field report that the municipal facilities are now well staffed. Growth in certified filtration plant operators is expected to be approximately 9% per annum or about 160 newly certified operators over the next several years. But, as pointed out above, this growth does not necessarily represent new employment, although a net increase in operator employment is likely to occur. Field sources indicate that graduates of the water/wastewater curricula often encounter difficulty in finding jobs in municipal waterworks operations. Many municipalities prefer to hire their own residents for such positions, and since most utilities offer on-the-

job training to new entrants, many utilities feel it is unnecessary to hire a non-resident college trained operator.

F. Conclusion

Regulatory responsibilities and attendant staff could expand quite rapidly for the Division of Water Supply when the state assumes primary enforcement responsibility for the Safe Drinking Water Act. Proposed legislation will require the presence of a certified operator on every shift at filtration plants and will also require the licensing of distribution system operators. These changes, along with the expected growth in the Division of Water Supply staff, will be accompanied by a substantial increase in the need for both operator and in-house training. The need for training of operators is necessitated further by the fact that many persons who become operators have had no prior training or experience in the field. The Division is making preparations for training, which it plans to carry out primarily through the use of its own personnel. In addition, the Division will continue to use the resources of U.S. EPA, the American Water Works Association and the state colleges/universities. Field research indicates that community colleges and vocational/technical institutions can contribute most effectively to training water supply personnel by emphasizing upgrade training, either through short or semester-long courses held in the late afternoon or early evening.

Besides state staff growth and some growth in laboratory staffing, little other increase is expected since the municipal utilities

are already well staffed. Much of the increase in the numbers of certified filtration and distribution system operators will be the result of recruitment from the ranks of unlicensed utility personnel. There will, however, be some net increase in the number of certified operators over the next five years.

V. RADIATION

A. Introduction

Primary responsibility for radiation protection is vested in the Michigan Department of Public Health, Bureau of Environmental and Occupational Health, Division of Radiological Health. This Division is responsible for carrying out the following functions: developing and conducting programs for evaluation and control of hazards in the use of radioactive materials and electronic sources of ionizing radiation, promulgation and enforcement of rules for control of nonproductive radiation exposures, licensing and registration of radioactive materials, investigation of ionizing radiation sources and facilities, operation and collection of data from monitoring systems in the vicinity of facilities which emit significant quantities of radioactive material, preparation of emergency plans to protect occupational or public health and safety, implementation of contracts with federal agencies, and responding to public health emergencies or incidents involving radioactive materials. Michigan is not an NRC agreement state.

B. Workforce Profile

The Division of Radiological Health has a professional staff of eleven to carry out the functions listed above. The staffing of the Division is set forth in the following table.

TABLE XI

MICHIGAN DEPARTMENT OF PUBLIC HEALTH

Division of Radiological Health
Current (1976) Staffing Level

Position	1976
Engineer	1
Physicist	7
Chemist	1
Technician	1
Other	2
TOTAL	12

The Division is divided into two sections: Licensing and Compliance Control and Nuclear Facilities and Contract Control. Of the twelve positions shown above, seven are in Licensing and Compliance Control. They include one chief, five health physicists, and one radiological technician. The other five positions are in the Nuclear Facilities and Contract Control Section. They include one chief, one chemist, two health physicists, and one industrial health engineer.

Private sector data concerning numbers of individuals employed in radiation protection is not available at this time. The number of facilities using industrial X-ray devices in Michigan is 226. Each of these facilities is likely to have a safety officer, often an industrial hygienist, responsible for the proper use of the equipment. In addition, the 1,767 hospitals and 71 clinics using medical diagnostic machines may also have one person in each facility responsible for the equipment. These persons may be health physicists, although this may not be true in the smaller clinics.

There are three nuclear power plants in Michigan. These plants will also employ a safety staff, many members of which are likely to be health physicists.

C. Workforce Projections

Over the next five years the environmental monitoring staff of the Division of Radiological Health will probably increase by approximately two persons, according to Division sources. A doubling or tripling in staff would be ideal to handle the increasing workload in environmental monitoring that will result from the planned operation of additional nuclear power plants.

Five nuclear power plants are expected to become operational over the next five years. This undoubtedly will cause an increase in the number of health physicists and other personnel employed in radiation protection.

D. Training and Certification

The Division of Radiological Health utilizes many of the available federal training programs such as those provided by the EPA, the Nuclear Regulatory Commission, the Bureau of Radiological Health, Department of Health, Education and Welfare, and the Department of Transportation.

Division sources indicate that there is not sufficient health physics training at the undergraduate level. That is, courses are often too academic and do not teach the skills necessary for the job. Consequently, there is a shortage of trained personnel available, and the Division must provide extensive on-the-job training to compensate for this.

E. Career Potential

It appears that career opportunities will be available for health physicists and other degreed engineers and scientists as a result of nuclear power plant planning and construction. Managerial and supervisory personnel will have to have radiological and nuclear background and many technical positions will require a working knowledge of various aspects of radiation.

F. Conclusion

Clearly, the majority of workforce growth in environmental protection from radiation will result from the growth in the number of nuclear power plants. Engineers, physicists, biologists, and other scientists, as well as skilled mechanics, will find opportunities in the nuclear power industry. The workload in environmental monitoring for the Division of Radiological Health will increase significantly because of the power plants. However, because of budget constraints, staffing is expected to increase only minimally.

VI. SOLID WASTE

A. Introduction

Responsibility for solid waste management was originally vested in the Michigan Department of Public Health. In 1973, the Division of Solid Waste Management was reassigned to the Michigan Department of Natural Resources (MDNR). The Division is now called the Resource Recovery Division. The Division's functions include licensing land disposal sites, incinerators, transfer stations, processing plants, and refuse transporting units and providing consultation to local government, private enterprise, consultants and local health departments on the operation, management, and control of solid waste facilities. The Division staff now attempts to provide surveillance and assistance in enforcement activities where local health department involvement is not adequate. Legislation introduced this year, if passed, would require the certification of local health departments and would then permit the Resource Recovery Division to add staff for surveillance activities.

Local health departments are expected to inspect each refuse disposal facility at least twice annually with more frequent inspection of large operations, and to submit an evaluation report. They are also responsible for investigating complaints and reviewing all solid waste plans developed for areas under their jurisdiction before such plans are submitted to MDNR. Finally, local health departments are responsible for inspecting refuse transporting units.

Although local health departments are given significant responsibility for solid waste management, their degree of involvement is left to their discretion, and their reviews, inspections and reports can range from superficial to comprehensive. The MDNR has no authority to require program cooperation from the local departments, although it can assume the responsibilities of the local departments when they choose not to exercise their authority. However, the MDNR does not have the authorized staffing or budget to compensate for the lack of activities at the local level. As a result of the Department's dependence on local health departments, the efficacy of the regulatory program is often reduced.

Since Michigan is a highly industrialized state with a large number of firms engaged in heavy manufacturing, many facilities use and dispose of potentially hazardous materials. MDNR estimates that at least 9,000 facilities use one or more materials on the latest Register of Critical Materials published by the Michigan Water Resources Commission. In addition, over thirty percent of Michigan's land is used for agriculture. Agricultural operations utilize pesticides and fertilizers regularly. Consequently, a high priority need for Michigan is the development of a sound program for hazardous waste management. This activity is presently in the initial stages.

In 1974 the State Legislature passed a resource recovery act to promote the development of resource recovery facilities. The

Act established the Resource Recovery Commission. The Commission is composed of the Director of the MDNR, the State Treasurer, and nine members representing cities, counties, townships, industry, and the public, with preference for persons with environmental backgrounds. The Commission is studying various alternatives for future solid waste management for the state as well as reviewing the Department's program and policies. Emphasis is on resource recovery and source reduction.

Another important aspect of the Commission's authority which is presently utilized is the conducting of hearings (show cause). These hearings, at which violators of the Licensing Act are brought before the Commission to testify on the status of their operations, have resulted in a number of signed consent orders which have established an improvement schedule without the usual time and expense of court proceedings. The hearing process before the Commission has, therefore, proved to be an effective enforcement mechanism.

B. Workforce Profile

Data for the workforce profile were obtained through on-site and telephone interviews with professionals in the field. Of particular assistance was the chief of the Resource Recovery Division, MDNR.

The Division has a professional staff of eleven persons. The current staffing level, by position, is shown in the following table.

TABLE XII

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

Division of Resource Recovery
Current (1976) Staffing Level

Position	1976
Engineer	4
Sanitarian	5
Geologist	2
TOTAL	11

The engineers hold the position of sanitary engineers, and three are registered professional engineers. The sanitarians have bachelor's or master's degrees in environmental health and hold the position of environmental sanitarian. One geologist holds a doctorate in geology, and the other has a bachelor's degree in geology. Except for one environmental sanitarian stationed in Escanaba in the Upper Peninsula, the entire staff presently operates out of the Division headquarters in Lansing.

Sources at the Division estimate that there are approximately 600 landfills currently in operation around the state. About 350 are licensed sanitary landfills. Approximately 400 open dumps have been closed since 1974. Field research suggests that the 250 unlicensed landfills may be open only several days each week and that some owner/operators may operate more than one landfill. Accordingly, there may be a total of about 550 landfill owner/operators in the state. An approximation of the staffing distribution in solid waste operations is shown in Table XIII.

TABLE XIII

STATE OF MICHIGAN

Division of Resource Recovery
Current (1976) Staffing Level

Position	1976
Landfill owner/operator	550
Heavy Equipment Operator	400
Weighmaster	5
Spotter	200
Other	50
TOTAL	1,205

Division sources estimate that there are 5,000 drivers employed in collection. Field research suggests that most collection vehicles are staffed by two or three person crews. If it is assumed that the average crew size is 2.5 persons, a total of about 12,500 persons may be employed in collection. Approximately 7,500 persons of this total workforce may hold the positions of jumper and helper. Michigan has an estimated 70 transfer stations staffed by a total of about 90 persons.

Michigan does not yet have any municipal resource recovery facilities. There is some private sector activity in this regard, particularly metal salvaging operations. Technology is expanding to allow salvaging not only of ferrous metals but also of non-ferrous metals such as copper, brass, aluminum, and zinc. Sources in the field could provide no workforce estimates concerning resource recovery efforts in the private sector.

In total, then, there are eleven professional persons working in solid waste management at the Resource Recovery Division. In

addition, there may be over 13,000 persons employed in solid waste collection and disposal activities in the state.

C. Workforce Projections

Workforce projections are based on the best professional judgment of sources in the field. The Resource Recovery Division expects to add approximately fourteen professional members to its staff in the next five years. Additional degreed engineers and chemists will be required for increasing surveillance, hazardous waste, and resource recovery activities. In Fiscal Year 1977, an attempt will be made to acquire a resource recovery specialist and a source reduction specialist. A staffing growth of fourteen professionals over the next five years would represent a twenty-five percent per annum average increase. If the Resource Conservation and Recovery Act program on hazardous waste develops as proposed, the Resource Recovery Division could well expand its program staff by 50 people to enforce the hazardous waste transportation, storage, and disposal aspects of the federal law. There is practically no turnover among the professional staff. In fact, only one professional staff member has left since 1963.

In disposal operations, overall staffing is expected to increase as open dumps are closed down. However, the employment at licensed landfills is expected to remain fairly constant over the next five years. Workforce needs at licensed landfill sites that might result from the closing down of unlicensed dumps are expected to be offset by the use of more capital intensive technology. Seven or eight transfer

stations are expected to be added in the next five years, most of which will be one-person operations. Sources in the field suggest that the workforce in collection will expand as a result of open dumps being closed down and the continual growth in the quantities of solid waste generated. There may be a growth of approximately 500 persons per year added to the collection workforce for the next five years or a total addition of up to 2,500 persons by 1982. This growth would represent an average per annum increase of about four percent. Field research suggests that annual turnover in collection may be as high as thirty to forty percent. This is because of hazardous working conditions, relatively low pay, and little opportunity for advancement. Finally, three municipal resource recovery facilities are planned to begin operation within the next five years. However, sources in the field could not provide estimates for the staffing of these facilities.

D. Training and Certification

The Resource Recovery Division provides on-the-job training for its staff, as well as approximately four training programs annually for landfill operators and other solid waste management personnel. Approximately 250 persons attend these training sessions each year. The Division also cooperates with educational institutions by providing lecturers at the request of those institutions.

Division sources estimate that about 9,000 persons--refuse managers and operating personnel--are in need of technical and safety training. The Division, however, lacks sufficient staff and

funding to support such training. It is considering the development of an operator certification program similar to that which is in effect for waterworks and sewage treatment plant operators. However, sufficient funding has not been available for this purpose.

Various colleges and universities in the state offer sanitary engineering and environmental health curricula which train persons entering the solid waste management field. These institutions include the University of Michigan, Michigan Technological University, Michigan State University and Wayne State University which offer sanitary and environmental engineering degrees and Ferris State College which offers associate and bachelor degrees in environmental health.

E. Career Potential

The foregoing suggests that career opportunities in the MDNR in solid waste management and in disposal will be limited. Although the Resource Recovery Division anticipates more than a doubling of its professional staff by 1982, this growth represents the addition of only about fourteen persons. However, if money is forthcoming from the Resource Conservation and Recovery Act, career opportunities in the state government could improve considerably. Sources at the Resource Recovery Division emphasize that there is a particular need for chemists who have a specialized knowledge of hazardous wastes to work in hazardous waste management and laboratory analysis.

In disposal, net employment may decrease as open dumps are shut down. Although there may be a substantial increase in the number

of persons employed in collection, this type of job offers little or no opportunity for career development and, in addition, tends to provide poor working conditions.

Perhaps the greatest area of career potential is in resource recovery. Although specific workforce projections are not available, the planned operation of three municipal resource recovery facilities suggests that there will be career opportunities for both professionally and technically trained personnel. Civil engineers, geologists, and hydrogeologists who have specialized in solid waste management and resource recovery may find opportunities in planning and designing resource recovery facilities. Much of the equipment presently used for resource recovery was originally designed for other purposes and, therefore, is not always adequate for use in resource recovery operations. Accordingly, highly trained engineers are needed for equipment design. Mechanics, electricians, laborers, supervisors and administrators who are knowledgeable in solid waste management and resource recovery also may be in demand. Sources in the field point out that while mechanics, electricians, and laborers will require special skills for working in resource recovery, these jobs offer little opportunity for advancement.

F. Conclusion

Division sources indicate that they can not yet predict what the impact of the Resource Conservation and Recovery Act of 1976 will be. However, a special task force committee is assisting the

Division in making decisions for handling hazardous waste. Under discussion is the idea of having the state become the reservoir for the permanent storage of certain hazardous wastes, giving it perpetual control over the sites and thus preventing accidents. It has been suggested that, if profitable, private enterprise could maintain the operation of the storage system with the state providing care and control of the land. The Division also is investigating and encouraging resource recovery when feasible.

Although the only areas of growth in the field of solid waste management appear to be in collection, toxic waste handling, and resource recovery operations, serious training needs exist in all phases of solid waste management. Landfill operators and managers often lack adequate knowledge of proper practices as landfill operations become more diversified and complex. Training and research is also needed in the handling of hazardous wastes. The anticipated growth in resource recovery activities will require professional, technical, and managerial personnel, many of whom will need training in various aspects of resource recovery technology. Much training for professional positions will take place at the college and university level. Division sources suggest that vocational/technical institutions or community colleges can provide much of the necessary technical level training.

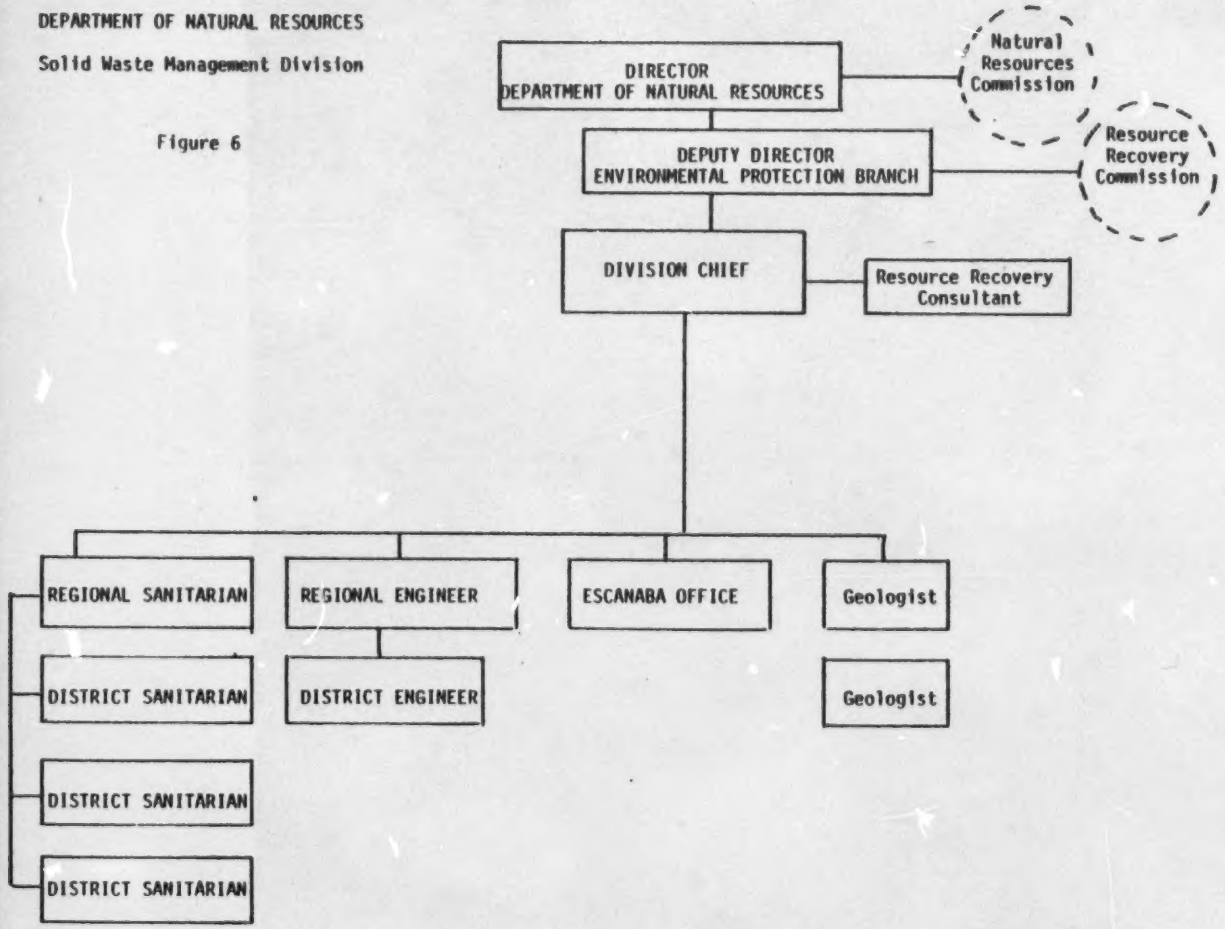
Finally, there is a need to provide training on a continual basis for the political decision makers in the functions and administrative

needs for solid waste management. Similarly, there is a need to promote public awareness of the issues involved in solid waste management and the economic, environmental, and social costs of various management alternatives.

DEPARTMENT OF NATURAL RESOURCES

Solid Waste Management Division

Figure 6



VII. WASTEWATER

A. Introduction

There are approximately 400 municipal wastewater treatment facilities in Michigan. Classification of these facilities is based on the population served, the type of treatment carried out, the character and volume of wastes to be treated, and the use and nature of the waters receiving the effluent. Each treatment facility is assigned one of the following classifications: A) serves or designed to serve population greater than 50,000; B) serves or designed to serve population between 10,000 and 50,000; C) serves or designed to serve population between 2,000 and 10,000; D) serves or designed to serve population less than 2,000; and L) treatment facility utilizing the waste stabilization lagoon process. Treatment facilities are designated further by the type of treatment carried out, i.e., primary treatment, trickling filter, activated sludge, and subclassifications of the treatment types. Operator certification is also divided into classes A, B, C, D, and L, with the A classification having the most stringent education and experience requirements and the D and L classifications having the least stringent requirements.

Industrial and commercial waste treatment facilities and operator certification are classified according to the type of treatment carried out as follows: A) Physical, B) Chemical, C) Biological. Each of these classifications is divided further into subclassifications based on a more specific category of treatment carried out. Operators for each type of system are certified according to a scale ranging from one to three,

with a rating of three having the most stringent education and experience requirements and one having the most stringent requirements.

There are approximately 1,619 active certified municipal wastewater treatment system operators and approximately 1,178 industrial and commercial operators in Michigan. The person in responsible charge of a system must be certified at the same classification level as the system.

Operating under the Water Resources Commission, the Water Quality Division of the Michigan Department of Natural Resources (MDNR), Bureau of Environmental Protection is responsible for the administration of Michigan's water pollution control program. The Division's functions include regulating wastewater discharges through issuance and enforcement of discharge permits and licensing of haulers of liquid wastes, water quality planning, monitoring water pollution problems, administering the Construction Grants Program, reviewing and approving plans for proposed treatment works, and training and certification of wastewater treatment plant operators.

Priority programs for the Division for Fiscal Year 1977 are the administration of the Construction Grants Program including grant management and administration, plan review and approval, enforcement and compliance monitoring of major discharges, and re-issuance of permits to major dischargers. Further priorities are licensing haulers of oil and hazardous materials and continuing the spill response and enforcement program, coordinating "208" planning agencies, laboratory quality assurance, toxic material monitoring, and conducting the surveillance fee program.

During Fiscal Year 1977 Michigan plans to allocate sufficient personnel to the Construction Grants Program to obligate available Fiscal Year 1976 funds which amount to 626 million dollars. Michigan has partial delegation of authority for this program and does not anticipate receiving further delegations in Fiscal Year 1977 unless such delegations can speed up the obligation rate. Michigan has encountered several problems in managing the grants program. First, various difficulties are continuously encountered in obtaining local agreement from governmental units. Difficulties relate to resolving study area boundaries, signing service contracts, adopting facilities plans, and designating lead applicants. Second, a continuous stream of new regulations tend to favor safeguarding tax dollar investments over the efficient obligation of funds. Third, communications are difficult because of the large number of parties involved in the grant program.

In Fiscal Year 1976, the Governor designated all fourteen regional planning groups as "208" agencies, and all have received planning grants. In Fiscal Year 1977 the Division will become more intensively involved in assisting the six planning agencies which have received grants most recently and whose grants are not large enough to support a full "208" plan. Three new positions will be funded to provide over-all program coordination.

B. Workforce Profile

Data for the workforce profile was obtained through on-site and telephone interviews with professionals in the public and private sector. Of particular assistance were Mr. Robert J. Courchaine, Division Chief, and Mr. Howard B. Selover, Chief, Training and Certification Section, Water Quality Division, MDNR.

The Water Quality Division presently has a staff of 79 professional and technical personnel. Table XIV illustrates the current staffing level by position.

TABLE XIV

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

Water Quality Division
Current (1976) Staffing Level

Position	1976
Engineer	34
Biologist	14
Technician	5
Other	26
TOTAL	79

The engineers are classified as sanitary engineers. Most have civil and sanitary engineering backgrounds, and many are registered professional engineers. Fourteen positions are classified as aquatic biologist and the staff members hold bachelor, master, and doctorate degrees in biology, fisheries, limnology and entomology. The technicians hold the position of water quality investigator. Many water quality investigators have associate degrees in biology or public health. The "Other" category includes seven water quality

administrators, five water quality supervisors, five conservation planners, five water resource planners, three wastewater treatment specialists, and one bacteriologist. Most of the water quality administrators and supervisors hold bachelor degrees in biology or public health. The planners are also degreed in a variety of disciplines including urban planning, geography, natural resources management, and engineering.

In 1976, the Environmental Services Laboratory devoted approximately sixteen person-years to water analysis. The Laboratory currently is staffed by thirteen chemists and six laboratory technicians. In total, then, there is a professional and technical workforce of about 100 persons in the state wastewater pollution control program.

The following table illustrates the distribution of certified municipal wastewater treatment plant operators by classification. The information was obtained from the certification records of MDNR.

TABLE XV

STATE OF MICHIGAN

Current (1976) Michigan Certified
Wastewater Treatment Plant Operators

Classification	1976
A	57
B	430
C	371
D	549
L	212
TOTAL	1,619

As pointed out earlier, the C and D classifications require the least education and experience and the A classification requires the

most. In addition 1,178 persons are certified in the industrial and commercial classifications. Furthermore, field research suggests that at the municipal systems there may be a workforce of up to 1,500 persons who are not certified operators. This workforce could include assistant superintendents, shift foremen, shift operators, maintenance supervisors, mechanics, chemists, laboratory technicians, laborers, and clerk-typists.

In summary, the state wastewater pollution control program, including laboratory personnel, employs nearly 100 professional and technical personnel. The municipal wastewater treatment facilities may employ up to 3,100 persons, and private industry employs approximately 1,178 operators certified for industrial and commercial wastewater treatment systems. In total, then, there may be a workforce of greater than 4,300 persons working in wastewater pollution control in Michigan.

C. Workforce Projections

Workforce projections are based on the best professional judgment of sources in the field. The Water Quality Division is requesting 78 new positions for Fiscal Year 1978. However, Division sources anticipate that over the next five years only about fifteen additional positions will be authorized. Growth is expected to be distributed among all positions, with about ten of the positions expected to be authorized and filled in Fiscal Year 1977. The wastewater pollution control program is currently understaffed. Consequently, the Division

estimates that approximately fifty additional person-years could be used in the following activities:

a) Construction Grants administration;
b) minor permit compliance tracking and enforcement;
c) water quality management funding;
d) laboratory certification;
e) increased O and M field inspections; and,
f) expanded spill response investigations.

The turnover rate for the Division for professional positions is low, between two and three percent per year. Sources at the Division indicate that turnover is low because salaries are competitive with those offered in the private sector.

The Environmental Services Laboratory expects to increase its staff by about thirty-five persons over the next five years. New positions will be for chemists, microbiologists, biologists, a bacteriologist and laboratory technicians. Some of this staffing increase will be devoted to analysis for the wastewater pollution control program. Although Laboratory sources could not provide specific turnover rates, they did indicate that turnover is a problem. Among the technicians, turnover is high because of low salaries and limited opportunity for advancement. Among the higher Civil Service grades for laboratory chemists, salaries cannot compete with those of industry.

Although the municipal treatment facilities will be expanding, growth in the number of certified treatment plant operators will be limited since much of the expansion will involve automated processes. Sources in the field anticipate that over the next five years, only about 200 new certified operators will be needed. If 200 operators

are added to the present workforce, there will be a total of about 1,800 certified municipal treatment plant operators by 1982. This would represent a growth rate of 2.5 percent per annum. The turnover rate among certified municipal treatment plant operators is reported to be approximately two percent per year. Thus, about thirty positions are vacated each year, mostly because of death or retirement. According to sources in the field, the turnover rate is low because of good opportunities for job advancement.

Field research suggests that many industries need additional persons for maintenance and operation of wastewater treatment plants. In addition, stricter rules pertaining to water quality standards are currently in the hearing stage. A change in the rules is likely to be forthcoming in the next five years. This, too, might lead to an increase in the private sector workforce. However, sources in the field are unable to provide specific workforce projections for private sector wastewater control activities.

It does not appear, then, that either the state wastewater pollution control program or the municipal treatment facilities will experience large staffing increases over the next five years. Water Quality Division sources indicate that a doubling of the current staff is necessary to adequately carry out the pollution control program, but only about twenty percent of the positions requested are expected to be authorized. There may be growth in the workforce for wastewater treatment operations in the private sector. At this time, however, no workforce projections for the private sector are available.

D. Training and Certification

The Water Quality Division provides informal on-the-job training for its new entrants. Division personnel also attend EPA training courses and technical conferences such as those of the Michigan Water Pollution Control Association. Sources at the Division indicate that as changes develop in the technology of treatment, Division staff members require further training. This training need has so far been satisfied by in-service training and by EPA courses.

The Training and Certification Section of the Division provides extensive in-plant training for municipal wastewater treatment plant operators and provides short training courses in various aspects of wastewater treatment. The Division has identified the following as top priority training needs for treatment plant operators for the success of the National Pollutant Discharge Elimination System: electrical maintenance, activated sludge process, laboratory analysis, training of lagoon operators, instrumentation, phosphorus removal procedures.

Below is a partial list of training that treatment plant personnel received between July 1975 and July 1976. Most of this training was conducted by Division staff members, although some training was done by college or university faculty.

Course	Attendance
Basic Wastewater Treatment	50
Intermediate Wastewater Treatment	43
Advanced Wastewater Treatment	23
Atomic Absorption in Spectroscopy Techniques	41
NPDES Requirements, Operator Certification Program, Flow Measurement, Activated Sludge	280
Activated Sludge	107
Electrical Maintenance	130

Division staff members made additional presentations to treatment plant personnel on such topics as the activated sludge process, the operator certification program, cyanide analysis in wastewater, and anaerobic digestion. Bay de Noc Community College and Northern University Skills Center offer an associate degree program in water treatment technology. Sources in the field point out that graduates of these programs have experienced some difficulty in finding jobs for two major reasons. First, there simply are not many openings for municipal wastewater treatment system operators, and second, when openings do occur, many communities prefer to hire their own residents. Often a community will hire a resident for an unskilled labor position at a wastewater treatment facility and, through on-the-job and short course training, the laborer can obtain promotion and certification. In many cases, a community will hire an untrained resident in preference to a nonresident who is a graduate of a water treatment training program.

Field research indicates that the most valuable role the community college or vocational/technical institution can play is in the area of upgrade training. Public and private sector sources emphasize that there is no need for further programs to train entry-level treatment plant operators. However, because of municipal politics which leave many new treatment plant operators and other personnel without prior training in the field and because of continual changes in the technology of treatment, upgrade training for Michigan's treatment plant personnel is the predominant educational need. As a consequence of this situation, community colleges may begin looking

more toward offering evening courses and short-term workshops than toward traditional daytime semester courses. Monroe County Community College, in particular, has begun to modify its environmental training program by offering more late afternoon and evening classes and additional short courses geared to upgrade rather than to entry-level training.

Various colleges and universities in the state also offer training in water pollution control. Among them is the University of Michigan which offers a B.S.E. degree in environmental engineering, M.S.E. degrees in Public Works Administration and Water Resources, and M.S. degrees in Water Resources Sciences and Water Resources Management. Michigan State University offers a B.S.E. degree in Civil Engineering with a water resources option.

E. Career Potential

The foregoing suggests that career potential both in the state regulatory program and in municipal wastewater treatment systems is limited. About fifty professional and technical personnel will be added to the state regulatory program in the Water Quality Division and in the Environmental Services Laboratory. There may be a demand for approximately 200 additional certified municipal treatment plant operators over the next five years, as well as about thirty additional operators per year to replace turnover. Although jobs for operators at municipal systems are not expanding rapidly, it appears that the opportunity for advancement in salary and position for those who are hired is quite good, especially at the larger systems.

The possibility of more stringent effluent standards may require industries to upgrade their treatment systems and utilize additional certified operators and maintenance personnel. Field research reveals that industries often choose personnel for these positions from among their own employees and then either provide them with on-the-job training or send them to community colleges or other sources for appropriate training. Consequently, an expanded workforce in industry either for wastewater treatment plant operations or maintenance may come from internal transfers and does not necessarily mean that there will be a commensurate increase in the number of persons employed by industry. Additional persons who may be hired to compensate for those workers who have been transferred into water treatment operations, will often be assigned duties which are not related to environmental protection.

F. Conclusion

The staff of the Water Quality Division is currently too small to adequately carry out all of the Division's responsibilities. Some increase in staffing is expected over the next five years, but sources at the Division anticipate that the increases will not be sufficient. Staffing at the municipal treatment systems is considered nearly adequate and will increase by approximately 2.5 percent per year mostly because of new plant construction. Further, the wastewater pollution control workforce of private industry may increase, but sources in the field could provide no estimates concerning the magnitude of the expected increase.

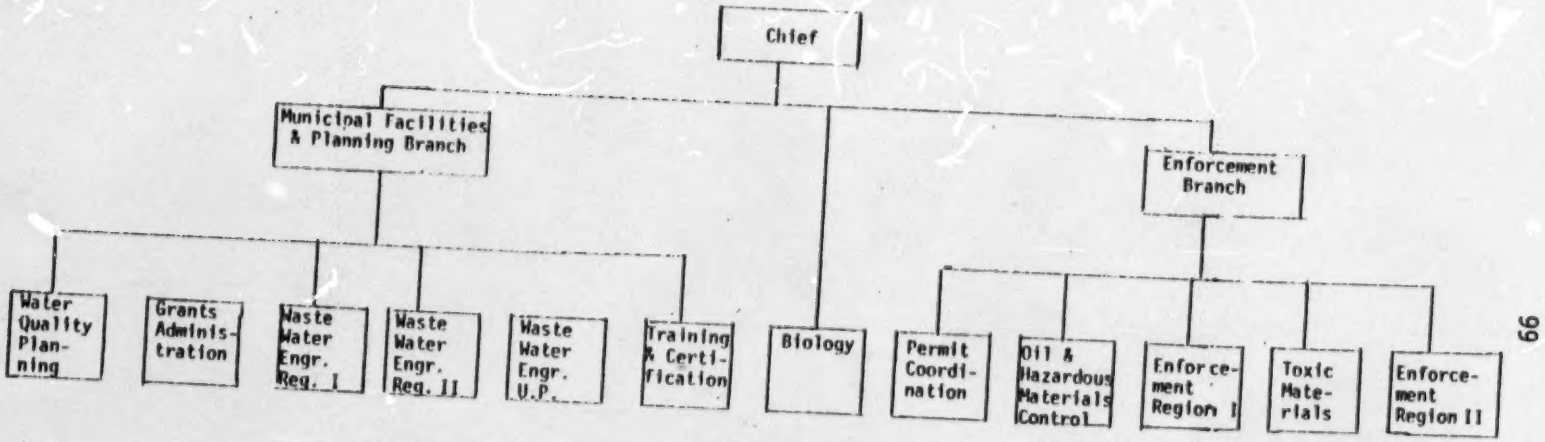
A consistent finding of field research in the wastewater control field in Michigan is that despite the extensive training efforts put forth by the Water Quality Division, there is, nevertheless, a need for upgrade training for Division, municipal, and industrial wastewater pollution control personnel. The Division staff requires upgrading as changes in the technology of treatment occur. Municipal personnel often enter their jobs with no prior training or experience in the field and thus require upgrading not only to keep abreast of changes in technology but also to supplement on-the-job training. Finally, many industrial wastewater control personnel also have little or no previous training in the field and therefore require training similar to that needed by municipal operational and maintenance personnel. As a result of this need for upgrade training, community colleges and vocational/technical institutions are encouraged to provide appropriate semester and short courses scheduled for the late afternoon and early evening so as to be accessible to persons who are employed.

Figure 7

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

Environmental Protection Bureau

Water Quality Division



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VIII. ENERGY

A. Introduction

Over 90 percent of Michigan's energy is obtained from other states. While Michigan has some reserves of bituminous coal and lignite, crude oil, natural gas liquids, and natural gas, price incentives serve to encourage energy consumption without encouraging energy production. Michigan has not yet developed complete or current information regarding the quantity of energy imported, consumed and produced. Consequently, valid short- and long-range policies are difficult to develop to address the energy supply problem.

The Energy Administration, created within the Michigan Department of Commerce in July 1976, was given responsibility for developing and coordinating a state energy policy. The Administration's functions include developing an energy conservation plan for the state government, achieving cooperation with business and industry for energy conservation, promoting energy research and development, assisting the Michigan Public Service Commission in forecasting supply and demand for energy, and preparing and distributing information to state officials, state agencies and the public.

Another organization of potential significance to the energy situation in Michigan is the Michigan Energy and Resources Research Association (MERRA). This organization combines representatives from the state government, universities, and industry in Michigan. Its function is to obtain funding to conduct energy-related research and to utilize the expertise within government, the universities, and industry to

carry out the projects. MERRA, then, does not itself perform research, development or demonstrations or act as a prime contractor. Instead, it helps organize project teams to carry out these activities.

B. Workforce Profile

Data for the workforce profile were obtained through on-site and telephone interviews with professionals in the field. Mr. John Sarver, Administrative Assistant, Energy Administration, provided valuable assistance in the collection of this data.

The Energy Administration has a professional staff of fourteen persons. It is divided into two sections: Conservation and Research and Policy and Government Affairs. Positions include a director, two deputy directors, an administrative assistant, three research and policy analysts, one fuel allocation officer, one education coordinator, three conservation coordinators, one energy information specialist and one wood energy specialist. The backgrounds of the staff members include public policy, law, political science, economics and forestry.

The major utilities in Michigan have been active in the energy field. They are currently exploring new coal gasification, direct combustion systems, and the feasibility of using solar energy and wind power. Sources in the field could not provide data on the number of persons involved in this research.

MERRA's only staff consists of its part-time president and one full-time research person.

C. Workforce Projections

Energy Administration sources anticipate a growth of approximately ten additional positions in the next five years. Having developed a core staff of generalists, this office will be seeking persons with more specialized skills in such areas as engineering, science, and statistics. It has not yet been determined what additional functions the Administration will assume in the future. Possibilities include developing an energy information system for the state, becoming directly involved in research, and expanding its public education role.

Workforce projections for the private sector are highly tentative at this time. Sources in the field anticipate that significant growth will occur in solar and other non- or low-polluting energy sources in approximately three to five years because of shortages of oil and natural gas and, therefore, increasing utility rates.

D. Training and Certification

Training for engineers, scientists, and architects is carried out through the various state colleges and universities. Especially active are the University of Michigan and Michigan State University which conduct both education and research in fossil fuels, nuclear and solar energy development and energy conservation.

E. Career Potential

Career opportunities are expected to develop over the next several years for degreed and highly trained engineers, scientists, and architects in energy research, product design and development, and building

design. Few career opportunities appear to be emerging for non-degreed vocational/technical personnel.

F. Conclusion

Currently, fourteen professional persons work full-time in the Energy Administration in energy conservation and policy planning. Over the next five years this workforce may increase by about ten persons. Probably the greatest opportunities for career development will be in the private sector and in the universities where research, development, and design regarding alternative energy technologies and energy conservation will be carried out. Consequently, there may be opportunities for highly trained scientists, engineers, and architects. Specific projections for this workforce cannot be made at the present time.

Selected Post Secondary Institutions With Formal Environmental Energy Programs

Michigan's higher education institutions, at every level, are putting forth extensive instructional effort in the field of pollution control and abatement. State universities such as University of Michigan, Michigan State University and Western Michigan University provide a wide array of environmentally-related curricula including undergraduate and graduate level degrees in engineer, agriculture, various other sciences, and public health. All are available with environmental emphases. On the four-year college level, Ferris State College is noted for its environmental health, environmental health technician, and pesticide technology curricula. On the two-year college level Monroe County Community College offers an associate's degree in environmental technology and Bay de Noc Community College offers a water pollution control and purification technology program. The foregoing overview is by no means exhaustive; it serves only to highlight some of the educational programs available in the state.

The following information for the University of Michigan and Bay de Noc Community College is an example of some of the elements and characteristics of programs offered by a senior institution and a community college.

SENIOR INSTITUTION

University of Michigan
Ann Arbor, Michigan

Program: Civil Engineering
Sanitary Engineering specialization (B.S.E., M.S.E.)
Environmental Engineering specialization (B.S.E.)
Water Resources Engineering specialization (B.S.E., M.S.E.)
Water Resources Sciences specialization (M.S.)
Municipal Engineering specialization (B.S.E., M.S.E.)
Public Works Administration specialization (M.S.E.)

Ph.D.s offered in various areas of specialization

Hours Required for B.S.E.: semester: 128; at least nine hours required in designated courses for specialization

Hours Required for M.S.E.: semester: 30

Hours Required for Ph.D.: No general course or credit requirement. In most areas, student must pass a comprehensive examination in a major field of specialization and in supporting fields

Staff size (principal staff): Three professors, one associate professor (4 Ph.D.s)

Enrollment:	Bachelor's	Master's	Doctorate
Sanitary	5	7	5
Environmental	1	-	-
Water Resources Eng.	7	17	10
Water Resources Sci.	-	2	-
Municipal	n/a	n/a	-
Public Works Adm.	-	3	-
TOTAL	13	29	15

Graduates (1976):	Bachelor's	Master's	Doctorate
Sanitary	6	3	-
Environmental	0	-	-
Water Resources Eng.	4	8	-
Water Resources Sci.	-	2	-
Municipal	4	1	-
Public Works Adm.	-	1	-
TOTAL	15	15	3 (est.)

Placement and Graduate Work: Specific data is not available. Sources at the University indicate that all graduates have either found jobs or are continuing their formal education.

Courses (Selected Listing)

Hydrology I and II
Hydraulics
Environmental and Water Chemistry
Environmental and Water Chemistry Laboratory
Water Resources Engineering
Environmental Implications of Liquid Waste Control
Water Supply and Wastewater Engineering
Design of Hydraulic Systems
Coastal Hydraulics
Ground Water Hydrology
Microbiology for Engineers
Chemical Processes in Environmental and Water Resources Engineering
Sanitary Engineering Design
Water Purification and Treatment
Wastewater Treatment and Disposal
Solid Wastes Engineering
Industrial Waste Treatment
Wastewater Treatment and Disposal
Solid Wastes Engineering
Industrial Waste Treatment
Environmental and Water Resource Systems and Economics
Political Factors in Environmental and Water Resources Engineering
Stream, Lake and Estuarine Analysis I and II
Unit Operations in Environmental and Water Resources Engineering
Solid Waste Recycling
Special Problems in Environmental and Water Resources Engineering
Special Problems in Solid Waster Engineering
Operations Research in Environmental and Water Resources Engineering
Water Resources Research Seminar
Hydrological Research
Hydraulic Engineering Research
Environmental and Water Resources Engineering Research

Program: Environmental & Industrial Health (M.S., M.P.H., Ph.D., Dr.P.H.)

Specializations:
- Air Pollution
- Environmental Cellular Chemistry
- Environmental Chemistry and Physics
- General Environmental Health
- Hospital & Industrial Environmental Health
- Industrial Hygiene
- Raiological Health
- Environmental & Industrial Toxicology
- Water Quality

Hours Required for Major: Depends on background of the student

Program Inception: Environmental Health-1941
Industrial Health-1957

Staff size: 13 professors, 4 associate professors, 8 assistant professors, 3 lecturers, 2 assistant research scientists, 1 research investigator (4 M.S., 4 M.P.H., . LL.D., 20 Ph.D., 1 M.D.)

Enrollment: 139.5*	M.S.	M.P.H.	Ph.D.	Dr.P.H.	Non-degreed
Air Pollution	-	3.5	4.0	-	-
Environmental Cellular Chem.	2.0	3.0	6.0	-	-
Environmental Chem. & Phycics	6.5	2.5	8.0	1.0	-
General Env. Health	1.0	19.0	-	2.0	1.0
Hosp. & Institutional Adm.	1.0	-	5.0	-	-
Industrial Hygiene	8.0	13.0	5.0	-	-
Radiological Health	5.5	1.0	5.0	-	-
Env. & Industrial Toxicology	2.5	8.5	5.5	-	-
Water Quality	2.0	10.0	8.0	-	-
TOTAL	28.5	60.5	46.5	3.0	1.0

Graduates (1976):
- 32 M.S.
- 37 M.P.H.
- 13 Ph.D.

TOTAL 82

Placement: 80 (est.)

Continue Graduate Work: 2 (est.)

*Student counted as half if enrolled in joint degree program with another department.

Courses (Selected Listing)

Toxicology of Foods and Food Additives
Environment and Health I
Environment Physiology II
Principles of Environmental Health I
Computer Applications in Environmental Health
Elements of Environmental Biology I
Environmental Aspects of Cellular Chemistry and Function
Radiation in the Environment I and II
Equipment Sanitation Standards, Design, and Evaluation
Environmental Health Administrative Practice I
Economic Problems in Resources Administration Seminar
Environmental Planning
Principles of Microbiologic Decontamination
Environmental Chemistry
Fundamentals of Instrumental Methods of Chemical Analysis I and II
Fundamentals of Electron Microscopy
Essentials of Toxicology
Industrial Toxicology
Ecological Toxicology
Methods in Toxicology
Principles of Community Air Pollution
Health Factors in Air Pollution I
Water Quality Management I and II
Water Quality Management Practices
Water Pollution Biology
Water Pollution Biology Field Survey and Laboratory Procedures
Water Bacteriology
Microbial Ecology
Water Resources Development
Water Quality, Field and Laboratory Procedures
Environmental Systems Engineering
Research in Environmental and Industrial Health
Special Problems in Solid Waste Engineering
Chemical Analysis of Water
Applied Electrochemistry
Instrumental Methods of Chemical Analysis
Physiochemical and Biochemical Methods of Separation
Industrial Hygiene
Air Sampling and Analysis
Industrial Hygiene Sampling and Analysis
Air Pollution Chemistry
Advanced Studies in Water Science and Engineering
Water Supply and Quality Control Seminar
Radiological Health Seminar
Radiation Physics
Radiation Dosimetry
Radiation Biology
Sources and Control of Radioactive Waste

State Legislation

MICHIGAN GENERAL

TITLE:

Environmental Protection Act of 1970
Michigan Statutes 14.528

PURPOSE:

To provide for declaratory and equitable relief for protection of air, water and other natural resources of the state.

DEFINITIONS:

ADMINISTERING AUTHORITY:

Attorney General, Local Governments, State Agencies, Private Parties

AUTHORIZATIONS:

To maintain an action for declaratory or equitable relief for protection of air, water and other natural resources from pollution, impairment or destruction;
To provide for procedural, evidentiary and other rules in enforcement of the act.

MICHIGAN AIR

TITLE:

Air Pollution Control Act
Michigan Statutes 336.11

PURPOSE:

To control air pollution in the state for the protection of public health and welfare.

DEFINITIONS:

1. Commission
2. Air contaminant
3. Air pollution
4. Air cleaning device

ADMINISTERING AUTHORITY:

Air Pollution Control Commission
Department of Natural Resources

AUTHORIZATIONS:

To establish ambient air quality standards;
To issue construction and operation permits for source emissions;
To enter and inspect property to enforce the act;
To issue regulations pursuant to the act regarding emission standards;
To prepare a comprehensive air pollution control plan;
To serve as the state lead agency in air pollution matters.

PROHIBITED ACTS:

To cause or permit air pollution in violation of rules;
To fail to obtain proper construction or operation permits.

PENALTIES:

Fines of up to $10,000 and/or $2,000 per day.

MICHIGAN PESTICIDES

TITLE:

Pesticide Control Act
Michigan Statutes 286.551

PURPOSE:

To require the registration of pesticides and regulate their labeling and distribution; to license pesticide dealers and certify pesticide applicators.

DEFINITIONS:

1. Active ingredient
2. Adulterated
3. Agricultural commodity
4. Animal
5. Avicide
6. Certified applicator
7. Commercial applicator
8. Defoliant
9. Desiccant
10. Device
11. Director
12. Distribute
13. Environment
14. EPA
15. FIFRA
16. Fungi
17. Imminent hazard
18. Inert ingredient
19. Ingredient statement
20. Insect
21. Insecticide
22. Label
23. Labeling
24. Misbranded
25. Molluscicide
26. Nematode
27. Person
28. Pest
29. Pesticide
30. Place of business
31. Plant regulator
32. Private applicator
33. Protect health and environment
34. Registrant
35. Restricted use pesticide
36. Restricted use pesticide dealer
37. Rodenticide
38. Supervise
39. Unreasonable adverse effect on environment
40. Vendor
41. Weed

ADMINISTERING AUTHORITY:

Department of Agriculture

AUTHORIZATIONS:

To require registration of all pesticides;
To register pesticides for special local needs;
To issue experimental use permits;
To license restricted use pesticide dealers;
To establish standards for and issue certification to private and commercial applicators;
To declare pests and categories of pesticides;
To enter and inspect property in enforcement of the act;
To issue regulations pursuant to the act;
To issue stop-sale orders.

CERTIFICATION OR LICENSING:

All commercial and private applicators must be certified, and meet requirements which include knowledge demonstration; can be categorized as determined by Department.

PROHIBITED ACTS:

To apply restricted pesticides without certification;
To sell restricted pesticides without licesne;
To violate terms of certificates or licenses;
To fail to register pesticides;
To fail to comply with branding or labeling requirements;
To detach, alter, or destroy labels.

EXEMPTIONS:

Persons using general use pesticides on own premises;
Certain pesticide transporters;
Public officials.

PENALTIES:

Fines of up to $500.

MICHIGAN POTABLE WATER

TITLE:

Safe Drinking Water Act
Michigan Statutes - 1976

PURPOSE:

To protect the public health through the supervision and control of public water supplies.

DEFINITIONS:

1. Bottled drinking water
2. Contaminant
3. Department
4. Director
5. Imminent hazard
6. Living unit
7. Person
8. Plans and specifications
9. Political subdivision
10. Public water supply
11. State drinking water standards
12. Supplier of water
13. Water hauler
14. Waterworks system

ADMINISTERING AUTHORITY:

Department of Public Health

AUTHORIZATIONS:

To generally supervise and control public water supplies and suppliers;
To review and approve waterworks system construction and modification;
To issue regulations pursuant to the act regarding drinking water standards, classification of waterworks;
To supervise water supply testing and analysis;
To certify water treatment and distribution system operators;
To issue variances.

CERTIFICATION OR LICENSING:

All waterworks and distribution system operators must be certified in classification corresponding to the facility in which they work. Training and examination standards are to be developed.

PROHIBITED ACTS:

To fail to have properly certified operator for waterworks or distribution system;
To contaminate public water supplies;
To fail to maintain standards in public water supplies.

PENALTIES:

. Fine of up to $5,000 or one year imprisonment.

MICHIGAN RADIATION

TITLE:

Radiation Control Act
Michigan Statutes 325.451

PURPOSE:

To provide for the control of ionizing radiation and for federal agreements regarding radioactive materials.

DEFINITIONS:

1. Radioactive material
2. Ionizing radiation
3. Source of ionizing radiation
4. Department
5. Person
6. Registration
7. General license
8. Specific license

ADMINISTERING AUTHORITY:

Department of Public Health

AUTHORIZATIONS:

To enter into federal and state arrangements regarding controlling radiation sources;
To coordinate radiation control programs and issue regulations pursuant to the act;
To require licensing and registration of all radioactive materials and ionizing radiation sources;
To issue radiation emergency orders;
To enter and inspect property in enforcement of the act;
To monitor significant radiation sources.

PROHIBITED ACTS:

To manufacture, use, possess, transport or control radioactive material or ionizing radiation source without proper license or registration.

EXEMPTIONS:

Electrical equipment or low-level radiation sources;
Radioactive material under federal control;
Any source licensed or registered by federal agency;
Sound, radio waves and similar light sources.

PENALTIES:

Fines of up to $100 or 90 days imprisonment.

NRC AGREEMENT STATE: No

MICHIGAN SOLID WASTE

TITLE:

Resource Recovery Act
Michigan Statutes

PURPOSE:

To promote the conservation of natural resources through a resource recovery commission, a state solid waste management plan, and the reclamation and recycling of materials of value from waste.

DEFINITIONS:

1. Commission
2. Costs
3. Department
4. Director
5. Municipality
6. Notes
7. Person
8. Processing
9. Responsible municipality
10. Recycling
11. Region
12. Regional service authority
13. Resource recovery
14. Resource recovery facility
15. Revenues
16. Solid waste management plan
17. Source
18. Sate solid waste plan
19. Volume reduction plant
20. Waste
21. Waste disposal area
22. Waste facility
23. Waste management project
24. Waste management services
25. Waste management system

ADMINISTERING AUTHORITY:

Department of Natural Resources
Resource Recovery Commission

AUTHORIZATIONS:

To develop a state solid waste plan;
To provide financial and other assistance for waste management systems;

AUTHORIZATIONS (Cont'd)

To encourage development of waste management services;
To provide general guidance and standards for waste management projects, resource recovery, and other facilities;
To provide loans and contractual assistance in waste management system development;
To maintain records and file reports regarding waste management projects and systems.

PROHIBITED ACTS:

For a municipality to cause unlawful pollution or environmental damage, or fail to make progress in solid waste management.

PENALTIES:

Fines of up to $2,500.

MICHIGAN SOLID WASTE

TITLE:

Solid Waste Management Act
Michigan Statutes 325. 291

PURPOSE:

To provide for planning and conducting refuse management systems; to regulate garbage and refuse disposal centers; and to protect the public health.

DEFINITIONS:

1. Refuse
2. Garbage
3. Rubbish
4. Ashes
5. Commissioner
6. Health officer
7. Applicant
8. Refuse transfer facility
9. Refuse processing plant
10. Disposal area
11. Refuse transporting unit
12. Collection center

ADMINISTERING AUTHORITY:

State Department of Public Health

AUTHORIZATIONS:

To inspect and license proposed disposal sites;
To issue regulations pursuanat to the act regarding standards for transporting units and disposal areas;
To license transporting units;
To prepare standards for and give approval to local refuse disposal plans;
Allow local governments to establish junk collection centers.

PROHIBITED ACTS:

To dispose of refuse except at licensed disposal area;
To operate a disposal area without license.

EXEMPTIONS:

Local governing bodies with equal or more stringent regulations;
Disposal of own refuse on own land.

PENALTIES:

Violations are misdemeanor.

MICHIGAN WASTE WATER

TITLE:

Soil Erosion and Sedimentation Control Act of 1972
Michigan Statutes - 1972

PURPOSE:

To provide for soil erosion control and to protect the waters of the state from sedimentation.

DEFINITIONS:

1. Agricultural practices
2. Authorized public agency
3. Commission
4. County agency
5. County enforcing agency
6. Department
7. Earth change
8. Land use
9. Local agency
10. Local enforcing agency
11. Person
12. Public agency
13. Rules
14. Sediment
15. Soil Conservation district
16. Soil erosion
17. State agency

ADMINISTERING AUTHORITY:

Department of Agriculture
Water Resources Commission
Local Agencies

AUTHORIZATIONS:

To prepare a state plan and regulations for soil erosion and sedimentation control;
To review and approve site and land use plans;
To enforce regulations at local level;
To issue earth change permits.

PROHIBITED ACTS:

To engage in earth change activity without prior approval and a permit;
To engage in activity which presents a soil erosion problem or hazard to waters of the state.

EXEMPTIONS:

Sites of single family dwellings.

PENALTIES:

Violations are a misdemeanor.

MICHIGAN WASTE WATER

TITLE:

Water Resources Commission Act
Michigan Statutes 323.1

PURPOSE:

To create a Water Resources Commission to protect and conserve water resources of the state, and to have control over water pollution.

DEFINITIONS:

1. Person
2. Waters of the state

ADMINISTERING AUTHORITY:

Water Resources Commission

AUTHORIZATIONS:

To protect the state waters and control water pollution;
To undertake water pollution studies;
To issue regulations pursuant to the act;
To cooperate in efforts with other agencies;
To enter and inspect property to enforce the act;
To establish water pollution standards;
To certify commercial and industrial treatment facilities;
To require the filing of discharge reports.

PROHIBITED ACTS:

To discharge raw sewage or other injurious material into waters of the state;
To violate water pollution discharge standards;

PROHIBITED ACTS (Cont'd)

To occupy or fill flood plain lands;
To fail to file reports or interfere with enforcement of the act;
To operate uncertified facilities.

PENALTIES:

Fines of up to $10,000.

MICHIGAN WASTE WATER

TITLE:

Waterworks and Sewerage Systems Law
Michigan Statutes 325.201

PURPOSE:

To provide for the supervision and control of waterworks and sewerage systems including construction, classification and operator certification.

DEFINITIONS:

ADMINISTERING AUTHORITY:

Department of Public Health

AUTHORIZATIONS:

To have general supervisory control over public water supplies and sewage treatment facilities;
To issue regulations regarding the operation of waterworks and sewerage systems and to classify such facilities;
To certify, according to standards, waterworks and sewerage system operators;
To issue permits for construction of facilities.

CERTIFICATION OR LICENSING:

Operators of waterworks or sewerage systems must be certified in a classification corresponding to the facility.

PROHIBITED ACTS:

To operate a waterworks or sewerage system without proper certification;
To construct or modify facilities without permit.

PENALTIES:

Fines of from $25 to $100 or 90 days imprisonment.

MICHIGAN ENERGY

TITLE:

Michigan Energy Act
Michigan Statutes - 1976

PURPOSE:

To create an Energy Administration and to provide for development and coordination of state energy policies.

DEFINITIONS:

1. Administration
2. Council
3. Energy director
4. Person
5. Commission
6. Energy
7. Energy form
8. Energy supplier

ADMINISTERING AUTHORITY:

Michigan Energy Administration
Energy Advisory Council

AUTHORIZATIONS:

To develop, coordinate and implement energy policies and conservation plans;
To cooperate with Federal agencies regarding energy;
To undertake energy education activities;
To compile energy records and make reports to Governor and Legislature.